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ABSTRACT

Presented is a compendium of activities and reference materials in environmental education and energy education that was developed by participants in a year-long institute conducted by Tennessee Technolcgical University and sponsored by the National Science Foundation. The manual is divided into three sections. The first consists of 111 activities, categorized by subject area, for students in grades four through six. The second section is an annotated bibliography of 239 resource materials related to energy and environmental education and available through ERIC. An annotated listing of several hundred free materials for classroom use comprises the third section. (Author/WB)

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IDEAS AND ACTIVITIES FOR ENERGY/ENVIRONMENTAL EDUCATION: GRADES 4-6

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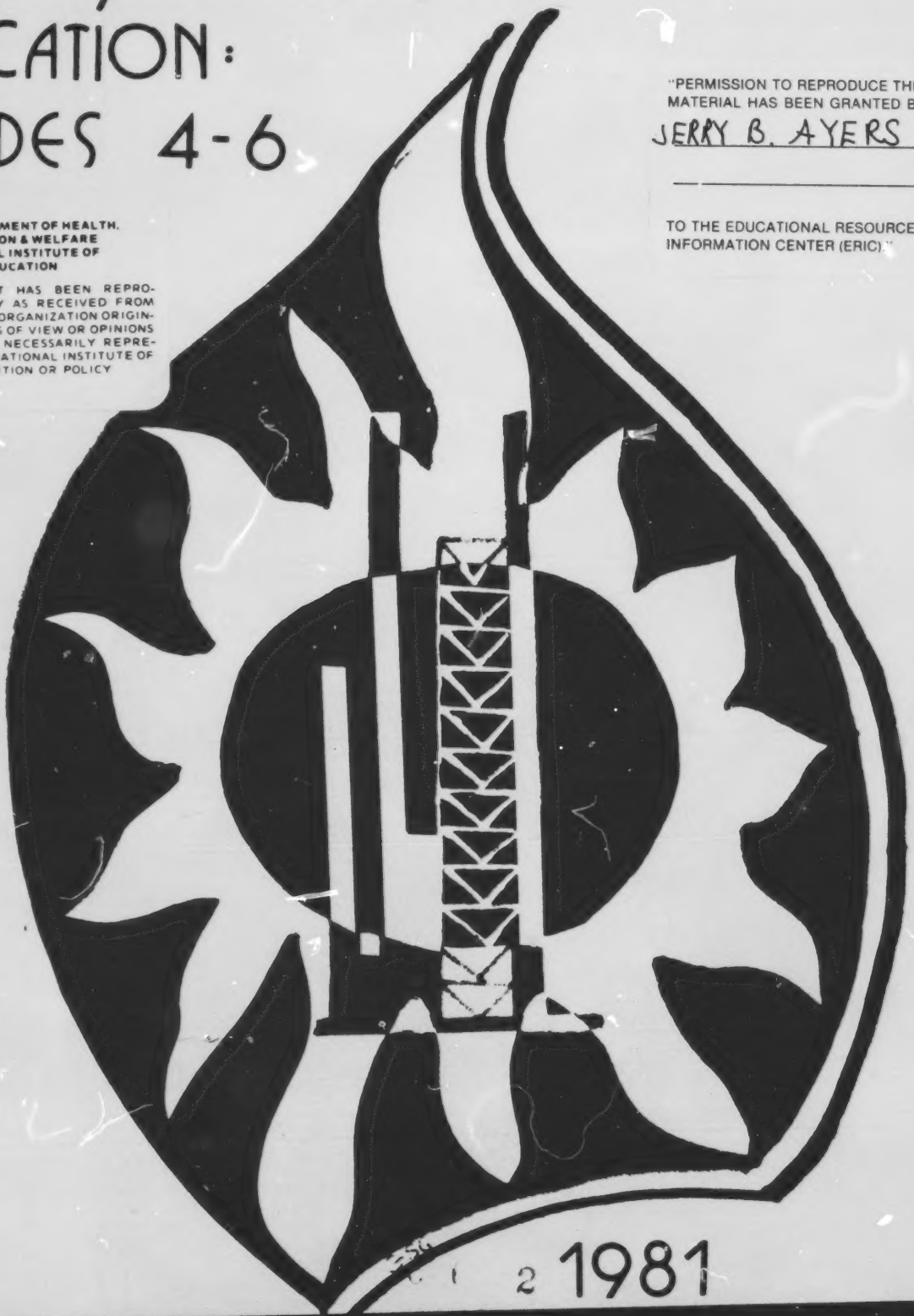

1981

IDEAS AND ACTIVITIES FOR ENERGY/ENVIRONMENTAL EDUCATION: GRADES 4-6

Prepared by

Students and Staff

of the

NSF Sponsored Institute Entitled

"Man's Energy Needs and Related Environmental Problems"

Prepared at

Tennessee Technological University
Cookeville, Tennessee 38501

April 1981

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TABLE OF CONTENTS

Page

Preface vii

Contributors ix

Introduction 1

Section

I. Energy/Environmental Classroom Activities 3

Art 5

1. Energy Awareness 7
2. Slide-Tape Presentation on Energy 8
3. Short-Term Economic Gains May Produce Long-Term Environmental Losses 9
4. Recycling Energy - Use Garbage 10
5. Save Energy - Recycle! 11
6. Wood - A Renewable Resource 12
7. Wind as a Source of Energy 13
8. Sun as a Source of Energy 14
9. Color and Heat Absorption 15
10. Heat and Color 16
11. An Adequate Supply of Clean Air is Essential Because Most Organisms Depend on Oxygen, Through Respiration to Release the Energy in Their Food 17

Health, Physical Education and Safety 19

12. How Much Energy Does Food Have? 21
13. What's Your Horsepower? 22
14. Save Energy - Ride a Bicycle! 23
15. How Fast Do Things Burn? 24

Industrial Arts 25

16. Passive Solar Heating 27
17. Do Windows Make a Difference? 28
18. Wind Power 29
19. Making a Wind Vane 30
20. A Model Solar Hot Water Heater 31
21. A Solar Distiller 32
22. The Solar Energy Situation 33

ucl

Page

Language Arts 35

23. Conserve Now for the Future 37
24. Energy Words 38
25. Words of Energy 39
26. The Good Old Days 41
27. Reading for Facts 43
28. Energy Yesterday, Today and Tomorrow 44
29. Energy Chains 45
30. Energy Editorial 46
31. Energy and the News 47
32. Let's Write a Poem About Energy 48
33. Creative Writing 49
34. The Best Present of All 51
35. Automobile Pantomine 53

Mathematics 55

36. Reading an Electric Meter 57
37. Energy Survey 58
38. Watts to Kilowatts 59
39. Mathematics in Energy 60
40. Comparing Miles Per Gallon 61
41. Comparing Fuel Sources of Today and Tomorrow 65
42. How Long Might Our Oil and Natural Gas Last? 67
43. Decimals 68
44. Percents 69
45. Fractions 70
46. Energy Awareness 71
47. Identification and Location of National Parks 72

Music 73

48. Make Music with Your Garbage 75
49. Steam is a Source of Energy 76
50. Manpower a Source of Energy 77
51. Let's Write a Song About Energy 78

Science 79

52. Energy Conservation 81
53. Energy Classification 82
54. Air Pressure 83
55. What is the Best Insulating Material? 84
56. What Really is Room Temperature? 85
57. Air Circulation and Temperature 86
58. How to Insulate an Ice Cube 87
59. Friction's Effect on Distance 88
60. Solar Energy 89
61. Can We Store Solar Energy? 91
62. Solar Water Heater 92
63. Concentrated Energy 93
64. Solar Energy Produces Sugar in Plants 94

Page

65. Static Electricity 95
66. Generating Electricity Using a Bicycle Wheel 97
67. Primary Energy Sources 98
68. Energy Sources 99
69. The Coal Situation 101
70. Coal as a Natural Resource 103
71. The Natural Gas Situation 105
72. Oil - How Fast Does it Flow? 107
73. Save Energy - Use Oil to Reduce Friction 108
74. Oil Shale 109
75. The Nuclear Reactor 111
76. Energy Flow 113
77. The Effects of Acid Rain on Plants 115
78. A Bioassay Using Strip Mine Leachates on Macro-invertebrates 116
79. The Effects of Acid (pH) Upon Aquatic Plant Life . . . 117
80. Waste Heat Upon Aquatic Macroinvertebrates 118
81. Ecological Relationships 119
82. An Adequate Supply of Pure Water is Essential for Life 121

Social Studies 123

83. The Energy Crisis 125
84. Energy Conservation 126
85. Energy and the Future 127
86. Energy Conservation 128
87. How Coal was Formed 129
88. The Good Old Days? 130
89. Past and Present Energy Sources 131
90. Energy, Past, Present and Future 133
91. Energy and Your Future Environment 135
92. How Coal is Used 137
93. Petroleum: From Nature to You 139
94. Synthetic Fuels 140
95. Problems and Solutions to Energy Problems 141
96. Can Anything Be Done? 143
97. Coal Facts: Costs and Benefits 145
98. Why Don't We Conserve 147
99. Where Savings Can Be Done 149
100. Nuclear Fission: Costs and Benefits 151
101. Oil from Shale? 152
102. Energy and Geography 153
103. Energy and Geography 154
104. Where We Get Our Energy: How We Use It 155
105. Energy Efficient City 156
106. Uses of Energy Sources 157
107. Land Pollution 159
108. Environmental Improvement 160
109. Water Pollution 161

Energy Fair 163

110. An Energy Fair 165

Page

Energy/Environmental Opinion Scale 167

111. Attitudes Toward Energy/Environmental Problems 169
Environmental Opinion Scale 171

II. Annotated Bibliography - ERIC 173

A. Energy: General Curriculum Guides 177

B. Energy Units and Activities 184

C. Environmental Education Curriculum Guides 193

D. Index of Materials According to Grade Level and Subject Area 209

III. Resources for Free and Inexpensive Energy/Environmental Materials 213

Selected References Listed By Subject 247

Selected Multidisciplinary References 250

Preface

During the 1980-81 school year Tennessee Technological University conducted, under the sponsorship of the National Science Foundation, a year-long institute entitled "Man's Energy Needs and Related Environmental Problems." The purpose of the program was to provide 30 teachers of grades 4-6 from Middle Tennessee the opportunity to substantially increase their basic science competency and interest in teaching energy/environmental education. In the fall of 1980, participants pursued work in environmental pollution and the underlying chemical, physical and biological principles controlling the behavior of pollutants in the environment. In the winter of 1981, emphasis was given to energy sources, needs, utilization and conversion. Then in the spring participants studied environmental problems associated with surface mining, power generation, energy utilization, and the environmental engineering principals used for the control of pollutants. Concurrent with the formal study of the cognitive aspects of energy/environmental materials, the participants developed and implemented in their classrooms, with the assistance of the project staff, a series of activities for their children. The end result of this latter task was the development of this manual entitled Ideas and Activities for Energy/Environmental Education: Grades 4-6.

This manual is not a total program for energy/environmental education for grades 4-6. The volume is, however, a collection of original activities and activities drawn from other sources that have been used in the classrooms of the institute participants to introduce energy/environmental education as a part of other subjects taught in the schools. For example, activities have been developed to introduce energy/environmental education in the classroom through the study of such areas as art, industrial arts and social studies. The majority of the activities were developed using a wide variety of free materials that are available from industry, governmental agencies and other organizations. Also, Ideas and Activities for Teaching Energy Conservation: Grades 7-12, prepared by the University of Tennessee Environmental Center, served as a guide for the development of new ideas. Relatively little expense is involved in the implementation of the activities in the schools. Many of the activities developed as a part of this project were used in grades above and below the target audience. However, it is felt that some use can be made of all of the activities in Grades 4-6, i.e., with exceptional children.

The manual is divided into three major sections. The first consists of 111 activities for use in the schools. The second section contains an annotated bibliography of related documents and guides available through the collections of the Educational Resources Information Center, that will be of use as resource material for teachers. The third section contains an annotated bibliography of free materials. Many of the items contained in this latter bibliography were used in constructing the activities contained in this manual.

The contributors' section includes the names and addresses of the principal individuals who worked on this project. A special word of thanks should go to several individuals for their selected contributions to this project. These individuals include the following: Dr. John Colozzi of the Tennessee Energy

Authority, Nashville, Tennessee, suggested the original idea for the development of this manual. Mrs. Terry Huffman, Secretary, Office of the Associate Dean, College of Education, Tennessee Technological University, served as the principal secretary for the Institute, typed much of the material contained in this manual, and compiled the annotated bibliography of free materials (Section III). Mrs. Pamela Ownbey, Graduate Teaching Assistant, College of Education, Tennessee Technological University, assisted with the editing of this manual, typing of selected sections, contributed several original activities to the project, and compiled the annotated bibliography of ERIC materials (Section II). Mrs. Glenda Qualls, Analyst, Office of the Associate Dean, College of Education, Tennessee Technological University, was responsible for the design of the cover of this manual. Mrs. Sharon Heard, Secretary, Office of the Associate Dean, College of Education, Tennessee Technological University, assisted with some of the secretarial duties associated with the development of this manual. A special word of thanks is extended to those organizations that supplied free materials for use by the participants and staff of the institute, and to the staff of the Learning Resources Center of the College of Education, Tennessee Technological University, for the printing of this manual.

Comments about this manual are invited.

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Introduction

This manual is divided into three sections. The first section consists of a series of activities that have been successfully used by classroom teachers to introduce energy and environmental education in grades 4-6. The second contains an annotated bibliography of sources of materials available through the Educational Resources Information Centers that are related to energy and environmental education. The third section consists of an annotated bibliography of free materials that can be used by teachers in the classroom.

The activities that follow were developed and field tested by classroom teachers for classroom teachers in grades 4, 5 and 6. However, some activities were developed and used in the lower grades and at the junior high level. It is felt that all of the activities can be used with students in the target audience. More advanced students can achieve the objectives of the activities originally designed for use at the junior high level, and students with learning difficulties can easily achieve the objectives of the activities designed for use in the lower grades.

The activities in this manual were not designed to be used as a total unit of study in energy and environmental education. Rather it was felt by the developers that energy/environmental education should be introduced into the curriculum as a part of other subject areas. Therefore, the activities have been developed for use in conjunction with subjects found in the regular school curriculum. The activities have been divided into areas including: art, health, physical education and safety, language arts, mathematics, music, science, social studies, energy fair, and assessment. The last two areas consist of an activity centered around conducting an energy/environmental fair and the assessment of students' attitudes toward energy/environmental education.

SECTION I

ART

Activity 1
ENERGY AWARENESS

ART

Objective: Students will illustrate their energy awareness by creating bulletin boards, energy cartoons, and energy murals.

Procedure:

1. Have students create bulletin board displays of pictures, articles and clippings from current magazines and newspapers which depict the energy situation. Arrange to show these in school, public buildings and retail stores. These make impressive displays at energy fairs.

2. Have students draw cartoons on the energy shortage for display during energy fairs.

3. Have students make a mural which describes the uses of fuel from wood to nuclear fuel as man's technology advanced. Include wood, peat, lignite, coal, oil, natural gas, nuclear fission and nuclear fusion. (The project could involve several students, with some conducting research and others doing the artwork.) Energy murals are good lead-up activities to an energy fair.

Resources:

1. American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209.

2. American Nuclear Society, 244 E. Ogden Avenue, Hinsdale, IL 60521.

3. American Petroleum Institute, 1801 K Street, NW, Washington, DC 20006.

4. National Coal Association, 1130 Seventeenth Street, NW, Washington, DC 20036.

Activity 2
SLIDE - TAPE PRESENTATION ON ENERGY

ART

Objective: To give students an opportunity to prepare a slide - tape presentation on energy.

Procedure:

Have students develop a slide - tape program that could be used to teach others about energy.

1. Divide the students into groups.
2. Decide on a topic and the jobs to be done.
3. Assign jobs.
4. Write the program.
5. Make a list of the pictures to be taken.
6. Take pictures. Allow plenty of time for developing.
7. Arrange pictures in order to match program.
8. Make a tape to go with the slides.
9. Present it to P.T.O., other classes, etc.

Resources:

1. Center for Energy Information, 340 East 51st Street, New York, NY 10022.
2. Energy and Man's Environment, 224 SW Hamilton Suite 301, Portland, OR 97201.
3. National Energy Resources Organization, 821 15th Street, NW, Suite 636, Washington, DC 20005.
4. Tennessee Energy Authority, 709 Capitol Boulevard Building, Nashville, TN 37219.
5. Trohanis, Pascal L. "Present Audible Multi-imagery Environmental Ecological Education," National Science Teachers Association, 1742 Connecticut Avenue, NW, Washington, DC 20009.

Activity 3
SHORT-TERM ECONOMIC GAINS MAY PRODUCE LONG-TERM ENVIRONMENTAL LOSSES ART

Objective: Students will illustrate an understanding of the need to make the best possible use of our natural resources and come to feel the need for control of agencies and people which do not take precautionary measures to care for environments of the future.

Procedure:

1. Talk about things that are used for a short time, then discarded. Have students redesign them so they may be reused. Example: No return bottles, cans, paper plates. Have students make a list of things seen on the way to school that fit this category.

2. Design and make your own tote box that must last all of the school year. These could be graded at the end of the year.

Resources:

1. Center for Environmental Education, 1621 Connecticut Avenue, NW, Washington, DC 20009.

2. Tennessee Environmental Council (TEC), P. O. Box 1422, Nashville, TN 37202.

3. University of Tennessee Environmental Center, South Stadium Hall, Knoxville, TN 37916.

4. Wright, M. F., "Increased Awareness of Our Environment," School Arts, pp. 36-37, March 1972.

Activity 4
RECYCLE ENERGY - USE GARBAGE

ART

Objective: To investigate ways to save energy by recycling garbage.

Procedure:

Ask students to bring from home yesterday's garbage.

Listed below are several activities and art ideas that can be done with garbage. Your activities will depend upon your resources (garbage).

1. Put aside and clean and dry all bones. Try to reconstruct the animal using glue.

2. Mosaics and collages can be made from chips of egg shells, dried coffee grounds, or dried fruit peelings.

3. Egg cartons can be used for making caterpillars, trains, flowers, or anything else within the imagination of the group.

4. Milk carton creations - pencil holders, button box, litter box for the car, box to hold jewelry, recipes, photographs.

5. Plant hangers.

6. Children's toys.

7. Bird feeders.

Resources:

1. Erdahl, Berlyn J. Cyclopedic Treasury of Arts and Crafts Activities Using Scrap Materials. West Nyack, New York: Parker Publishing Company, Inc., 1977.

2. Lund, Cherie, and Chanelle Wolfe. Exploration with Garbage. Project ECO-logy. Highline Public Schools, Seattle, WA. Title III, ESEA. ERIC Document No. ED 132 008.

3. National Center for Resource Recovery (NCRR), 1211 Connecticut Avenue, NW, Washington, DC 20036.

4. Roukes, Nicoles. Classroom Craft Manual. Belmont, CA, Fearon Publisher, Inc., MCMLX.

Activity 5
SAVE ENERGY - RECYCLE!

ART

Objective: To collect natural materials and create a "recycled art" project.

Procedure:

Discuss the extending of material use by creating a new or different product from used or old material. This is considered a form of recycling.

Examples of recycling materials are:

1. Dry, press and mount flowers along with wood, straw and stone.
2. Large flat stones may be decorated with ecological signs or polished and combined into "stone sculptures."
3. Hold a sculpture session using wet sand, snow, or mud.
4. Create "original" animals from pine cones, nuts, berries, dried weeds, etc.

Resources:

1. Erdahl, Berlyn J. Cyclopedic Treasury of Arts and Crafts Activities Using Scrap Materials, West Nyack, New York: Parker Publishing Company, Inc., 1977.
2. Kohuth, Barbara J. and Boyd T. Marsh. An Educational Guide to Planning an Improved Human Environment. Hudson, OH, Inner Circle Press, Inc., 1974. ERIC Document No. ED 141 081.
3. Roukes, Nicholes. Classroom Craft Manual. Belmont, CA, Fearon Publisher, Inc., MCMLX.
4. University of Tennessee Recycling Project, 2300 Volunteer Boulevard, Knoxville, TN 37916.

Activity 6
WOOD: A RENEWABLE RESOURCE

ART

Objective: To provide an opportunity for students to understand that wood is a source of energy.

Procedure:

In this lesson you will need to stress the importance of preserving our forests, but also to use wood in our homes and businesses to produce heat or energy.

1. Make and discuss a list of things in our environment that uses or is made of wood.

2. Discuss with them how we use wood to heat our homes. Talk about how we may destroy a renewable resource by overusing it and not replenishing it.

3. Remember to discuss the importance of constant conservation. Then discuss how our intrusions in the forest can destroy forest lives.

4. Then have the children cut out pictures from old magazines or books and make nice collages about our renewable resource wood.

5. Display them in the room or hall.

Resources:

1. Agriculture, U.S. Department of (USDA), Washington, DC 20250.

2. American Paper Institute, Inc., Paper Stock Conservation Committee, 260 Madison Avenue, New York, NY 10016.

3. American Forestry Association, 1319 18th Street, NW, Washington, DC 20006.

4. Soil Conservation Society of America, 7515 NE Ankeny Road, Ankeny IA 50021.

Activity 7
WIND AS A SOURCE OF ENERGY

ART

Objective: To provide an opportunity to understand that wind is one of our sources of energy we can use.

Procedure:

The materials needed for this activity are: pencils, straight pins (one for each child), and a pinwheel pattern.

1. Give each child a ditto copy of the pinwheel pattern. Have them color it and cut it out. Fasten it with the straight pin and put through the top of the eraser.

2. Experiment with the pinwheel. Ask several questions like: does your pinwheel move if you don't blow on it? Then instruct them to blow easy. Does it move slow or fast? Have them blow harder: does it move slow or fast?

3. Take the pinwheels outside and test them with the wind outside. Then ask them if it moves slow or fast now.

4. What can we summarize about our pinwheels? What makes the pinwheels move? (wind)

Resources:

1. Forte, Imogene, Mary Ann Pangle, and Robbie Tupa. Pumpkin, Pinwhee's and Peppermint Packages - Teacher Edition. Nashville, TN Incentive Publications, 1974.

2. Wind Energy: Science Activities In Energy, U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

3. Wind Energy Society of America, 1700 E. Walnut Street, Pasadena, CA 91106.

Activity 8
SUN AS A SOURCE OF ENERGY

ART

Objective: To provide students with an opportunity to identify the sun as a source of energy.

Procedure:

This activity will bring about the idea of using the sun more in our lives. It is something that is there for the taking.

1. Do an experiment with an ice cube in the sun. Ask the children what is making the ice cube melt. (sun)
2. Discuss that the sun gives off heat. Talk about the difference in temperature when the sun is or is not shining.
3. Talk about the difference in being right in the sun or in the shade. Discuss what the sun does to the snow.
4. Then give the children an opportunity to draw and color pictures representing the sun as a source of heat.
5. Display the pictures in the room or hall.

Resources:

1. Environment Center, The University of Tennessee, South Stadium Hall, Knoxville, TN 37916.
2. Solar Energy: Science Activities in Energy, U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.
3. Solar Energy Society of America, P. O. Box 4264, Torrance, CA 90510.

Activity 9
COLOR AND HEAT ABSORPTION

ART

Objective: Students will understand that the color of a roof can affect the amount of heat a house absorbs.

Procedure:

1. Collect materials including: 3 empty milk cartons (the size the students have in the lunch room), white, black and red paint, and 3 thermometers.

2. Teacher will ask students about the color of their roofs. Discussion will be held if students think that color makes a difference in the temperature of their homes, especially if the proper amount of insulation is lacking.

3. Paint the milk cartons a different color. One white, one black, and the other red.

4. Place a hole in the side of each carton where the thermometer can be read without taking it from the carton.

5. Place the cartons in the sun. (Aluminum foil may be placed underneath to help the experiment go faster.)

6. Check the thermometers every five minutes. Record the results. (Be sure to check the thermometers before the experiment to check for variables in each thermometer. Another good idea would be to have a thermometer placed out with the cartons to serve as a control.)

7. Discuss with the students the results obtained. Discuss how this might help homeowners decide the color of their roofs in relation to energy conservation. Be sure they take into consideration the environment and climate and how that might affect the roof color.

8. Have the students design a house for birds, dogs, or other animal and choose the colors best suited for that animal's comfort during the period it will be used.

Resources:

1. Beeler, Nelson F., and Franklin M. Branley. Experiments with Light, Thomas J. Crowell Co., 1964.

2. Campbell, Anne. Let's Find Out About Color, Franklin Watts, Inc., 1966.

3. Paschel, Herbert P. The First Book of Color, Franklin Watts, Inc., 1959.

Activity 10
HEAT AND COLOR

ART

Objective: To understand the effects of heat and color.

Procedure:

1. Collect necessary materials including construction paper (one sheet of each color - red, blue, yellow, white and black). Others may be used also, but be sure to include these.

2. Explain to students that heat is reflected by some colors and absorbed by others. One way to measure the amount of heat that a color absorbs is this simple experiment.

3. Take the construction paper and fold into a box by turning up the sides and stapling the corners. Place a thermometer in the bottom of the box. Place clear plastic wrap over the box.

4. Now place the box out in the sun.

5. Note the temperature changes every five minutes. Note the differences. Which colors were cooler? Warmer?

6. After the observation, discuss with the students why they think they got the results that they got. What conclusions can they draw about colors?

7. Draw a diagram on the board showing how white reflects color, black absorbs all colors and when the eye sees colored objects, that object is actually absorbing that color and reflecting all other colors.

8. Explain that because of the differences in color, temperatures can differ among similar objects. (A special note should be taken here. Be sure you take the temperatures down of each thermometer before the experiment begins to check for variations among the thermometers themselves.)

9. Discuss how the color of clothes can help you stay warm in the cold months and cool in the warm months. Discuss how the color of your house may have an effect on your energy savings in some areas of the country.

Resources:

1. Better Heating-Cooling Council, 35 Russo Place, Berkeley Heights, NJ 07922.

2. "Motion, Matter and Energy." Man and Science Library, Vol. IV, Bell and Howell, 1969.

3. Soutin, Harry. Light Experiments for Home, Workshop and School Laboratory, W.W. Norton and Co., Inc., 1963.

Activity 11
AN ADEQUATE SUPPLY OF CLEAN AIR IS ESSENTIAL BECAUSE MOST ORGANISMS DEPEND ON OXYGEN, THROUGH RESPIRATION TO RELEASE THE ENERGY IN THEIR FOOD.

ART

Objective: Students will become more aware of the cause of air pollution.

Procedure:

1. After the students have visited a factory site, have them construct a factory, a bus, a car, etc., using boxes, cardboard, etc. Dry ice could be used to create smoke thus reproducing the causes of pollution.

2. Take the class to a busy intersection and have them observe. Draw the effect that many cars have on the clean air.

Resources:

1. Air Pollution Control Association, 4400 Fifth Avenue, Pittsburg, PA 15213.

2. Beck, A. W. "S.I.T.E. - A Suggested Answer to the Problem of Pollution in Art Teacher Development," School Arts, 71: 36-37, September 1972.

3. "Conserving Our Waters and Cleaning the Air" (teacher's guide and student manual), American Petroleum Institute.

4. Cosby, Bill. "Why is There Air," (audio-visual).

5. Hills, I. "Box Sculpture," Arts and Activities, p. 42, May 1970.

HEALTH, PHYSICAL EDUCATION AND SAFETY

Activity 12
HOW MUCH ENERGY DOES FOOD HAVE? **HEALTH**

Objective: To examine the caloric value and the heat produced by the various food groups.

Procedure:

1. Have students collect samples of the different food groups.
2. Using a tin can, thermometer, coathanger (wire), masking tape, aluminum foil, birthday candle and postage scale, measure the amount of heat produced by burning the food samples.
3. Prepare a chart or graph to illustrate the food source that produces the most potential energy for your body.

Resources:

1. Chemical Energy: Science Activities in Energy. U.S. Department of Energy Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.
2. Hendricks, William. Growth - A Handbook of Classroom Ideas to Motivate the Teaching of Elementary Health. The Spice Series. Stevensville, MI, Educational Services, Inc., 1973.
3. Tennessee Department of Public Health, 344 Cordell Hull Building, Nashville, TN 37219.

Activity 13
WHAT'S YOUR HORSEPOWER?

PHYSICAL EDUCATION

Objective: To help students evaluate their power in ft-lbs/sec and changes that occur with regular exercise programs.

Procedure:

1. Have students participate in timed activities such as stair climbing to measure their horsepower.

2. They will then chart or graph the initial data and then chart weekly as stair climbing is introduced into the daily exercise program.

   (a) Compute the work done by a housewife who weighs 140 lbs. in carrying a basket of wet clothes weighing 25 lbs. from the basement up the stairs to the ground level, which is 8 ft. higher than the basement floor.

   (b) If the time required to do this is 6 seconds, compute the power in horsepower.

   Solution:

   (a) $W = fd = (25 + 140)\ \text{lb} \times 8\ \text{ft}$
   $= 165\ \text{lb} \times 8\ \text{ft} = 1320\ \text{ft/lbs}$

   (b) $P = \frac{W}{t} = \frac{1320\ \text{ft-lbs}}{6\ \text{sec}} = 220\ \text{ft-lbs/sec}$
   $= \frac{220}{550}\ \text{hp} = .4\ \text{hp}$

Resources:

1. Roy, Mary M. Action: A Handbook of Classroom Ideas to Motivate the Teaching of Elementary Physical Education. Stevensville, MI 49127 Educational Services, Inc., 1967.

Activity 14
SAVE ENERGY - RIDE A BICYCLE!

SAFETY EDUCATION

Objective: To examine bicycles as energy savers and review safety precautions while riding.

Procedure:

1. Discuss with students the fact that bicycling is a very energy efficient means of transportation. It requires about one-half as much energy as walking.

2. Discuss and question such topics as:

   (a) Bicyle operation.
   (b) Safety in "bicycle games."
   (c) Appropriate bicycle.
   (d) Proper maintenance of bicycle.
   (e) Uses of bicycles: ex. short trips, errands, paper route.
   (f) Directions of safest routes to and from school.
   (g) Develop checklist of illegal and/or dangerous practices of bicyclists.
   (h) Develop test to show energy expenditure of walking vs. bicycling.

Resources:

1. American Association of State Highway and Transportation Officials, 341 National Press Building, Washington, DC 20004

2. The Bicycle Institute of America, Inc., 122 East 42nd Street, New York, NY 10017

3. The Bicycle Manufacturers Association, 1101 15th Street, NW, Washington, DC 20005

4. Consumer Information, Public Documents Center, Pueblo, CO 81009

5. Energy in the Classroom, Activity Guide for K-3. Virginia Energy Office, 823 East Main Street, Richmond, VA 23219, 1975.

6. Mroz, Joseph, Safety in Everyday Living. Dubuque, IA, William C. Brown, Publishers, 1978.

7. Safety, Tennessee Department of, Andrew Jackson State Office Building, Nashville, TN 37219

Activity 15
HOW FAST DO THINGS BURN?

SAFETY EDUCATION

Objective: To examine the speed with which various materials burn and safety procedures during a fire.

Procedure:

1. Discuss the general composition of various everyday materials and demonstrate the rate of combustion of each.

2. Discuss and question topics such as:

   (a) Home building materials
   (b) Clothing
   (c) Smoke inhalation
   (d) Anatomy and spread of a fire
   (e) Early fire warnings
   (f) Planning an escape route
   (g) Practicing an escape route
   (h) Fighting the fire
   (i) Preventing home fires
   (j) Measure the energy production of the different materials burned

Resources:

1. Forte, Imogene, Mary Ann Pangle, and Robbie Tupa. Pumpkin, Pinwheels, and Peppermint Packages - Teacher Edition. Nashville, TN, Incentive Publications, 1974.

2. Mroz, Joseph. Safety in Everyday Living. Dubuque, IA 52001, William C. Brown Publishers, 1978.

3. The National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

4. National Safety Council, 44 North Michigan Avenue, Chicago, IL 60602

5. National Smoke, Fire and Burn Institute, 53 State Street, Suite 833, Boston, MA 02109

6. U.S. Consumer Product Safety Commission, 5401 Westbard Avenue, Washington, DC 20207

INDUSTRIAL ARTS

Activity 16
PASSIVE SOLAR HEATING

INDUSTRIAL ARTS

Objective: To help students design a house with passive solar heating characteristics.

Procedure:

1. Have students design a house with passive solar heating characteristics.
2. Blueprints for the house must be of quality to enable the construction of a model to determine effectiveness of design.
3. Temperature differentiation can also be determined if model is large enough and appropriately constructed.

Resource:

1. Industrial Arts Manual to the Construction of Miniaturized Alternative Energy Source Equipment. Energy Management Center, P. O. Box 190, Port Richey, FL 33568. (Price: $12.00)
2. Passive Solar Heat for New Home Construction. National Center for Appropriate Technology, P. O. Box 3838, Butte, MT 59701.
3. Passive Solar Heating. U.S. Department of Energy Office of Conservation and Solar Applications - Systems Development Branch, Passive Solar Systems Development Program, 1980, GPO: 0-312-766, Government Printing Office, Washington, DC 20402.
4. Solar Bibliography. National Center for Appropriate Technology, P. O. Box 3838, Butte, MT 59701 (50¢).
5. Solar Energy Society of America, P. O. Box 4264, Torrance, CA 90510.

Activity 17
DO WINDOWS MAKE A DIFFERENCE? INDUSTRIAL ARTS

Objective: To show students the importance of the location of windows and the usage of insulation.

Procedure:

1. Collect the following materials: two cardboard boxes (same size), white paint or white paper, two thermometers, plastic wrap, knife, masking tape, insulating materials.

2. Cut a large hole in one side of both boxes. Cover the holes with plastic wrap and tape the wrap tightly over the holes. Paint both boxes white, or cover them both with white paper.

3. Place a thermometer in each box. Record the temperature in each box and put them in the sun, one facing the sun, and one facing away from the sun.

4. Record the temperatures after ten, twenty, thirty minutes. Record the information on a chart. Then you could try the same thing only insulate both boxes. Try different insulating materials.

Resources:

1. American Institute of Architects, 1735 New York Avenue, NW, Washington, DC 20006.

2. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19102.

3. Conservation Science Activities in Energy. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

4. Solar Energy: Science Activities in Energy, U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

Activity 18
WIND POWER

INDUSTRIAL ARTS

Objective: To help students design a wind powered device to operate a small electric motor and construct a model to test design.

Procedure:

1. Have students design a windmill with capabilities of powering a small electric motor.

2. Blueprints for the device must be of a quality to enable construction of the model to determine effectiveness.

3. Construct and test the model.

Resources:

1. Industrial Arts Manual to the Construction of Miniaturized Alternative Energy Source Equipment. Energy Management Center, P. O. Box 190, Port Richey, FL 33568 ($12.00).

2. Wind Bibliography. National Center for Appropriate Technology. P. O. Box 3838, Butte, MT 59701 (30¢).

3. Wind Energy: Science Activities in Energy. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

4. Wind Energy Society of America, 1700 E. Walnut Street, Pasadena, CA 91106.

Activity 19
MAKING A WIND VANE

INDUSTRIAL ARTS

Objective: To help students understand the direction and velocity of the wind.

Procedure:

1. Collect the following materials: feather, straw, pin, pencil, glue, scrap wood, glass bead, tin can, tin shears.

2. Put a drop of glue in the shaft of the feather. Stick the feather shaft into a soda straw. Balance the straw with the feather on a ruler edge.

3. Stick a pin through the straw at the point where it balances. Push the pin into the pencil eraser. Blow on the feather to make sure the wind vane turns easily.

4. Take the wind vane outdoors away from any building. Hold the pencil away from your body and find which way the wind vane points. What do we use to tell the direction? This wind vane is too delicate to leave outdoors permanently.

Make a permanent wind vane for school:

5. Make the cross piece from a piece of wood about 20 inches long. Saw grooves in each end for the tail and rudder of the wind vane.

6. Use the tin shears to cut two pieces of metal from the tin can. Make sure the tail of the wind vane is larger than the arrow. Slide the pieces of metal into the gooves in each end of the cross-piece and fasten each end of the cross-piece and fasten each with a small nail.

7. Find the balancing point of the cross-piece and drill a small hole at that spot. Put a smaller nail through the hole in the cross-piece and fasten to a long stick. Be sure to place a glass bead between the cross-piece and the upright stick. The bead helps the wind vane to turn easily.

8. Place the completed wind vane in an open area where everyone can see it.

Resources:

1. Wind Energy: Science Activities in Energy. U.S. Department of Energy Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

2. Wind Energy Society of America, 1700 East Walnut Street, Pasadena, CA 91106.

Activity 20
A MODEL SOLAR HOT WATER HEATER INDUSTRIAL ARTS

Objective: To understand how solar hot water heaters operate.

Procedure:

This experiment demonstrates a direct method of capturing solar energy. These methods transform sunlight itself into useable forms of energy.

1. The heart of a solar hot water heater is a device called a collector. It collects, or captures, solar energy and uses that energy to heat water. The collector must be aimed toward the south so that it collects the maximum possible amount of sunlight during the day.

2. To build a model solar collector, you start by covering the inside of a box with black paint, paper cloth, or other dark material.

3. Then loop the tubing back and forth inside the box. Arrange for both ends of the tubing to be sticking out of the sides of the box a couple of feet.

4. Next, place the glass cover on the box and secure it with tape. We're now ready for the test.

5. Wait for a sunny day and find an open area. Place the collector on a stand with a pan or bucket of water next to the collector. Put one of the tubing ends into the water. Suck gently on the other end to establish a siphon action. Once water starts to flow through the tubing, pinch the tubing partially with the clothespin to limit the flow of water to a small trickle.

6. Notice that after a while, the water trickling from the tubing will be warmer than the water siphoning into the collector. Solar energy absorbed by the tubing is transferred to the water, thereby heating the water. How warm the water gets will depend mostly on the time of year, how clear the sky is, and how slowly the water flows through the collector.

Resources:

1. Alternative Energy Sources. Thomas Alva Edison Foundation, Cambridge Office Plaza, Suite 143, 18280 West Ten Mile Road, Southfield, MI 48075.

2. Center for Energy Information, 340 East 51st Street, New York, NY 10022.

3. Solar Energy Industries Association, 1001 Connecticut Avenue, NW, Suite 632, Washington, DC 20036.

4. Solar Energy Society of America, P. O. Box 4264, Torrance, CA 90510.

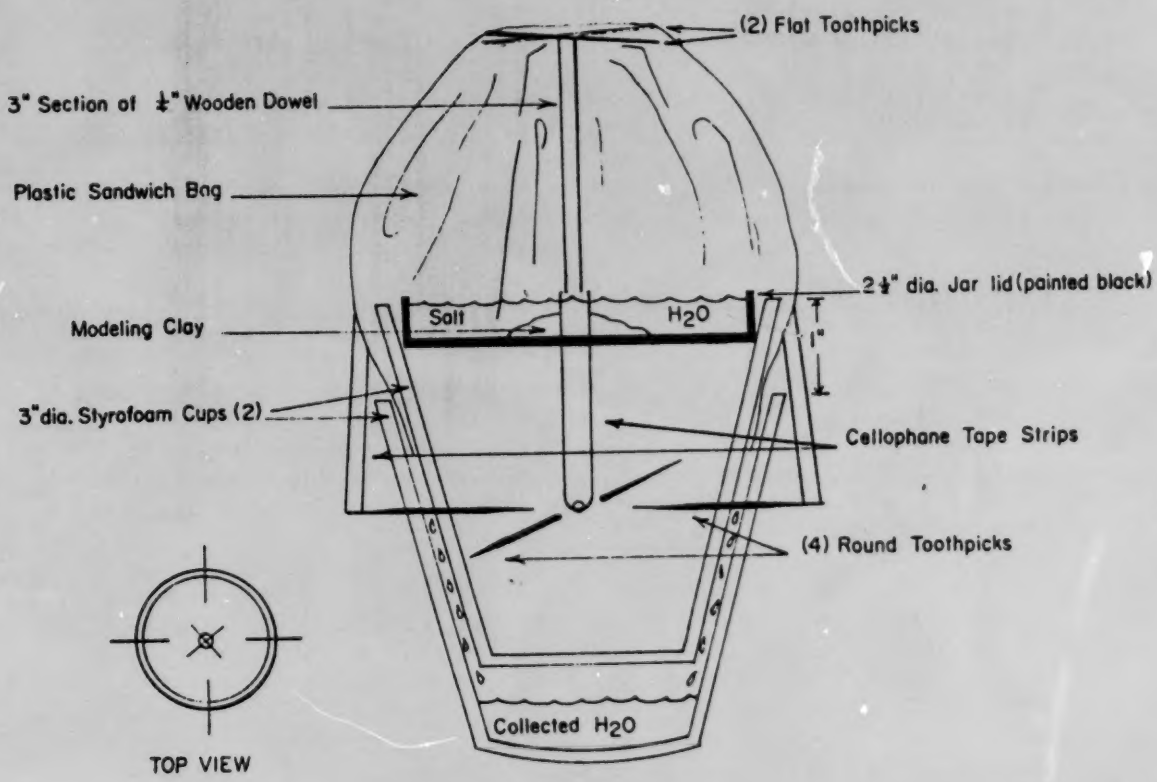
Activity 21
A SOLAR DISTILLER

INDUSTRIAL ARTS

Objective: To help understand the application of solar energy to a practical problem.

Procedure:

This experiment which is simple in design illustrates that every student can have his own solar still. The processes of evaporation and condensation are implied.



While the experiments are working a discussion of solar energy can be held.

Resources:

1. Solar Energy: Science Activities in Energy. U.S. Department of Energy Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830, March 1980.

Activity 22
THE SOLAR ENERGY SITUATION

INDUSTRIAL ARTS

Objective: To help students develop an understanding of the construction and function of a solar cooker.

Procedure:

Have students review and discuss several solar cooker designs.

Questions and discussions should include:

1. What is the purpose of each design?
2. What are the material costs of each design?
3. What design is easier to build?
4. What are the advantages of each cooker?
5. What are the disadvantages of each cooker?

Students should construct and test the solar cookers. They should also determine the efficiencies of the different models.

Resources:

1. Solar Energy Industries Association, 1001 Connecticut Avenue, NW, Suite 632, Washington, DC 20036.
2. Solar Energy: Science Activities in Energy. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.
3. Solar Energy II: Science Activities in Energy. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.
4. Solar Energy Society of America, P. O. Box 4264, Torrance CA 90510.
5. University of Tennessee Environment Center, South Stadium Hall, Knoxville, TN 37016.

LANGUAGE ARTS

Activity 23
CONSERVE NOW FOR THE FUTURE

LANGUAGE ARTS

Objective: To help students realize how conservation could be part of their everyday habits.

Procedure:

1. Each student will made a list of twenty things they use every day that takes electricity to work.

2. After their list is complete, they are told that half of all the oil supply mysteriously disappeared. Therefore, they will have to cut back their electrical use by 50%. They are now to take their list and mark through ten items that they can live without. The students will now write a paragraph on how they can do without these items.

3. Now the students are to choose the 3 most important things on their list. Through group discussions, talk about how we can really conserve on energy in our everyday use of electricity.

Questions for thought:

1. Can you do without some of the things you use everyday?

2. If every student in the class saved on energy use for one item, would it help?

3. How about if every student in the U.S. conserved on one item each day, would it help?

Resources:

1. Concern, Inc., 2233 Wisconsin Avenue, Washington, DC 20007.

2. Environment Center, South Stadium Hall, The University of Tennessee, Knoxville, TN 37916.

3. General Electric Company, P. O. Box 500, New Concord, OH 43762.

4. International Business Machines Corporation, Armonk, NY 10504.

5. Tennessee Energy Authority, 709 Capital Boulevard Building, Nashville, TN 37219.

6. Tennessee Valley Authority, 400 Commerce Avenue, Knoxville, TN 37902.

Activity 24
ENERGY WORDS

LANGUAGE ARTS

Objective: To help students become familiar with vocabulary related to energy.

Procedure:

Give students a list of vocabularly words related to energy. Have them study the list for an energy spelling bee.

Some suggested words are:

1. fossil
2. fuels
3. gasoline
4. hydroelectric
5. kilowatt
6. oil
7. fission
8. fusion
9. wind
10. work
11. energy
12. geothermal
13. calorie
14. conservation
15. coal
16. solar
17. tidal
18. atom
19. uranium
20. fuse

Resources:

1. Center for Energy Information, 340 East 51st Street, New York, NY 10022.

2. Center for Environmental Education, 1621 Connecticut Avenue, NW, Washington, DC 20009.

3. Energy Education Project, 324 Henson Hall, University of Tennessee, Knoxville, TN 37916.

Activity 25
WORDS OF ENERGY

LANGUAGE ARTS

Objective: To help students become familiar with energy terminology.

Procedure:

1. Divide the class into groups of 5 each.

2. Each group will be given a list of energy related terms. As a group they will prepare a dictionary of energy terms. These terms will be put in alphabetical order. Then, their pronunciations will be prepared, parts of speech, and meanings. Also, some illustrations can be given.

3. When this is finished, a cover can be made with an illustration about energy on the front cover.

Resources:

1. American Petroleum Institute, 2101 L Street, Northwest, Washington, DC 20037.

2. Energy Education Program, 324 Henson Hall, University of Tennessee, Knoxville, TN 37916.

3. U.S. Department of Energy, Energy Information Administration, 1000 Independence Avenue, Washington, DC 20585.

4. Your school's science series.

Activity 26
THE GOOD OLD DAYS

LANGUAGE ARTS

Objective: To develop in the student an awareness of what life was like before the large scale use of oil and natural gas.

Procedure:

Each student will do an interview with someone who is old enough to remember what life was like before the day of great usage of oil and natural gas. They will be given a list of suggested questions to ask:

1. What kind of lights did you use in your home?
2. How was your home heated?
3. What did a work week consist of in days and hours?
4. How much did you get paid?
5. How did you get to work?
6. What fabrics were clothes made of?
7. Was clothing harder or easier to take care of?
8. What sort of washing machine did you have?
9. What kind of stove did you have?
10. How did you get to school?
11. Did your family own a car? How much did it cost?
12. What kinds of entertainment did you enjoy?
13. How did you heat bath or laundry water? What were soaps like?
14. What were the eating facilities in your school?
15. What did you have for school supplies?
16. How did you keep food from spoiling?
17. Did your family go on vacation? Where did you go?
18. What happened to your old schoolhouse?
19. How did school change with the coming of school buses?
20. How do you think the car changed things in your town?

(Over)

When the interview is completed, the student will then write a summary to turn in about the interview they conducted.

Resources:

1. The Energy Challenge, Department of Energy, Washington, DC 20545.
2. History of Energy, Department of Energy, Office of Consumer Affairs, The Education Programs Division, Washington, DC 20585.
3. Local Historical Society.
4. Local Newspaper
5. Tennessee Energy Authority, 709 Capitol Boulevard Building, Nashville, TN 37219.

Activity 27
READING FOR FACTS

LANGUAGE ARTS

Objective: To help students read a story and decide what is fact and what is not, and implications for our society on energy needs.

Procedure:

1. Have the students read (or the teacher may read to the class) the story "Life in 1990" by Isaac Asimov.

2. Make a list of the things which he predicts for 1990 that are facts for 1981. They may also make a list of the thinks that are still fantasy today but may prove to be facts in the future.

Resources:

1. Fay, Leo, Myron L. Coulter, Bruce Lloyd. The Young America Basic Reading Program, Lyons and Carnahan, Chicago, IL 1972.

Activity 28
ENERGY YESTERDAY, TODAY AND TOMORROW LANGUAGE ARTS

Objective: To develop in the student a knowledge of where our energy comes from, where it is being used, and how long it will last.

Procedure:

1. Charts, graphs and diagrams will be prepared to show from what countries our fossil fuels come. Also, another will be made to show in what percentages the different sectors of our society use the fuels.

2. A graph will then be made to show how long each fossil fuel will last.

3. When these materials are finished, they can be organized into a bulletin board on energy.

Through preparing these materials the students will learn how to read charts, graphs and diagrams.

Resources:

1. Amoco Educational Services, Public Affairs MC 3705, P. O. Box 5910-A, Chicago, IL 60680.

2. The Energy Future Today, U.S. Department of Energy, Washington, DC 20585.

3. Environment Center, The University of Tennessee, South Stadium Hall, Knoxville, TN 37916.

4. Federal Energy Administration, 12th and Pennsylvania Avenue, NW, Washington, DC 20461.

5. Resources for the Future, Inc., 1755 Massachusetts Avenue, NW, Washington, DC 20036.

6. Solar Energy Project, Curriculum Services, NY State Education Department, Albany, NY 12234.

Activity 29
ENERGY CHAINS

LANGUAGE ARTS

Objective: To examine the basic importance of energy.

Procedure:

1. Ask each student to select any item that they can see in their home, school, or street.

2. Ask the student to list the kinds of energy associated with the item. If it moves, what makes it run? Does it transform energy from one kind to another? Does it store energy? What kind? What kinds of energy were used in its manufacture? What energy do you need to use it?

3. Assign a one-page essay in which students should attempt to describe the "energy chain" associated with the object they choose.

Resources:

1. Tennessee Conservation League, 1720 West End Avenue, Suite 600, Nashville, TN 37203.

2. Tennessee Energy Authority, 709 Capitol Boulevard Building, Nashville, TN 37219.

3. Where Does America Get Its Energy? - Energy Conservation Activities for Young Learners. Office of Conservation Education, Federal Energy Administration, Washington, DC.

Activity 30
ENERGY EDITORIAL

LANGUAGE ARTS

Objective: The student will demonstrate his knowledge of the energy problem in our school by writing an editorial on "Energy Conservation in Our School."

Procedure:

1. After the energy unit has been presented, an assignment to finalize the unit should be given. This assignment to write an editorial about energy conservation in our school will be a contest for the best paper.

2. The student will investigate and research the problem then write an editorial of the good and bad things being done in conserving energy in our school.

3. The best editorial will be published in the school newspaper.

Resources:

1. Alliance to Save Energy, 1925 K Street, NW, Washington, DC 20461.

2. Center for Energy Information, 340 East 51st Street, New York, NY 10022.

3. Educational Facilities Labs, Inc., 850 Third Avenue, New York, NY 10022.

4. Tips for Energy Savers, Federal Energy Administration, Washington, DC 20461.

Activity 31
ENERGY AND THE NEWS

LANGUAGE ARTS

Objective: To help students use inference, main idea, skimming or scanning reading skills with articles related to energy.

Procedure:

1. Take newspaper articles related to energy and cut off the headlines.
2. Students are asked to read the article and then write a headline for it themselves.
3. The students are given both the article and headline and asked, as quickly as possible, to match the headline with the correct story.
4. For a creative writing activity, give the students only the headline and let them write their own news story.

Resources:

1. Forte, Imogene, Mary Ann Pangle and Robbie Tupa. Cornering Creative Writing Learning Centers, Games, Activities and Ideas for Elementary Classroom. Nashville, TN, Incentive Publications, 1974.
2. Handbook for use of the newspaper usually available through publishers in large cities.
3. Hazard, John, ed. Providence Journal Newspaper in Education Teacher Activity Book. Providence, RI, Providence Journal, September 1978.

Activity 32
LET'S WRITE A POEM ABOUT ENERGY LANGUAGE ARTS

Objective: To illustrate to students that they can use poetry to describe how they feel about many things, including energy.

Procedure:

There are two types of poems to be used in describing energy.

1. The first type is called Cinquain. It has a one word title, the first line has two words describing the title, the second line has three words to express action, the third line has four words expressing a feeling, and the fourth line has one word restating the title.

   Example:

   ENERGY

   Strong, dirty,
   Scraping, grinding, burning
   Anger, danger, gluttony, guilt
   Power.

2. The second type of poetry is called Haiku. It is a highly structured oriental poem with seventeen syllables in three lines. The first and third lines must contain five syllables and the second must contain seven syllables. The lines do not have to rhyme. Give the poem a title.

   Example:

   ENERGY

   Powerful, costly
   Changed our way of life and times
   Less and less each day.

Resources:

1. Forte, Imogene, Mary Ann Pangle, and Robbie Tupa. Cornering Creative Writing Learning Centers, Games, Activities and Ideas for Elementary Classroom. Nashville, TN, Incentive Publication, 1974.

2. Smith, James A. Adventures in Communication Language Arts Methods, Boston, Allyn and Bacon, Inc., 1972.

Activity 33
CREATIVE WRITING

LANGUAGE ARTS

Objective: To provide students with an opportunity to use their understanding of energy in a creative writing situation.

Procedure:

Give the students a list of titles or leading lines which deals with energy or related subjects. Have them choose one and write a story or theme and share them with the class.

1. The night everyone set back their thermostat to 68°. . .
2. What would happen if we woke up and there was no more gasoline?
3. Life in 2020.
4. The day I used no electricity.
5. What if the sun refused to shine?
6. The day everyone began using coal.
7. What would happen if there was a melt down at the Watts Bar Nuclear Power Plant?
8. Where did the trees go?
9. When I turned on the faucet there was no water so I . . .
10. How can "I" help the energy crisis?

Resources:

1. Forte, Imogene, Mary Ann Pangle and Robbie Tupa. Cornering Creative Writing Learning Centers, Games, Activities and Ideas for Elementary Classroom. Nashville, TN, Incentive Publications, 1974.
2. Smith, James A. Adventures in Communication Language Arts Methods. Boston, Allyn and Bacon, Inc., 1972.

Activity 34
THE BEST PRESENT OF ALL

LANGUAGE ARTS

Objective: Students should be able to make and/or decorate a simple costume or scene to use for a play, take part in acting out an energy story, and apply what they learn in the story setting to what is real life.

Procedure:

1. This is a narrative which can be read to your class first as a story to be enjoyed. Then you might want to invite another class to see it.

2. Discuss the various characters and make plans for acting out the story as it is narrated. The characters are: King Oliver, Wise Men, Page Boy, Mr. Oil, Mr. Gas, Mr. Coal, Mr. Atom, General Water, Mr. Geothermal, and the Golden Sun. The list can be extended to include people of the court. Some children might be used as stage hands to decorate and set up the throne. Try to involve everyone in some way. The King may give lollipops to the court at the end of the play.

3. At some time after the play, review what they have learned from the story. Ask the children what materials can be used to produce heat and light energy. Discuss the pros and cons of each form of energy. This should be kept simple but they should be encouraged to understand concepts.

Form of Energy	Good About It	Not Good About It
Oil	Easy to transport	Expensive, Scarce May leak and spill Gasoline causes air pollution
Gas	Clean	
Gas	Clean	Expensive Limited supply
Coal	More available	Pollutes the air May spoil the environment (strip mining)
Atoms	Available Clean	Poisonous Waste
Water	Clean	May spoil rivers and streams Not enough available
Geothermal	Clean No poisonous waste	Available only in limited places

(Over)

Form of Energy	Good About It	Not Good About It
Sun/Wind	Unlimited amount available Doesn't spoil the environment	Presently expensive

Resources:

1. "The Best Present of All," adapted with permission from Ranger Rick's Nature Magazine, National Wildlife Federation, 1412 Sixteenth Street, NW, Washington, DC 20036.

2. Platts, Mary E. Spice - A Handbook of Classroom Ideas to Motivate the Teaching of Primary Language Arts. Stevensville, MI, Educational Service, Inc., 1973.

3. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

Activity 35
AUTOMOBILE PANTOMINE

LANGUAGE ARTS

Objective: Students will be able to identify oil as a source of energy and understand the role it plays in the smooth running of daily activities.

Procedure:

1. Have the students play "Automobile Pantomine." Tell children they might like to be parts of a car. They are to come up to the front of the room and make themselves look like a certain part of the car. A child may choose to become the motor, and other children to be the front end, back end, four wheels, and a driver.

2. Ask: What do we need to make the car go? Who puts gas in the car? Have children to volunteer to put gas in the car.

3. Ask: What can the car do now that it has gas? Let all the children who make up the car move forward together. Have several other children come to the front of the room and become parts of a larger car - a trunk perhaps. Follow the same procedures, and ask questions that would elicit the response that a bigger car uses more gasoline than a small one. Perhaps they will infer this idea by the number of children needed to form the larger car. When the children return to their seats, say: Let's make up a story about the gasoline station attendant. What words will he need to know? Allow the students to give suggestions.

4. Arrange a field trip to a nearby gas station.

Resources:

1. American Automobile Association, 8111 Gatehouse Road, Falls Church, VA 20042.

2. Exxon Corporation, 1251 Avenue of the Americas, New York, NY 10020.

3. General Motors Corporation, Public Relations Staff, General Motors Building, Room I-101, Detroit, MI 48202.

4. Gulf Oil Corporation, Gulf Building, Pittsburgh, PA 15230.

5. Mobile Oil Corporation, 150 East 42nd Street, New York, NY 10017.

MATHEMATICS

55

Activity 36
READING AN ELECTRIC METER

MATHEMATICS

Objective: The student will learn to read an electric meter and figure the cost of electric usage in the home.

Procedure:

1. The students will be shown how to read an electric meter, using samples. They will be told to begin at the left and to read across. If the needle is between two numbers, take the reaing of the lowest number.
2. They will also be told that the utility company charges them for the kilowatt hours used based on the difference between two readings taken approximately one month apart.
3. The student will practice reading meters on samples.
4. Read their home meters two days in a row at the same time each day.
5. Figure their kilowatt usage for those days by finding the difference between the first day reading and the second day reading.
6. Figure their cost for those days basing their cost on $ .04/day.
7. Look at their parents' actual electric bill to see their kilowatt usage for the month.
8. Compare their usage with that of their peers.

Resources:

1. Elementary School Science Series, McGraw-Hill Book Company, Webster Division, New York.
2. "Energy Activities." Division of Science Education, North Carolina Department of Public Instruction, Raleigh, NC 27611.
3. Local electric company.
4. Parents.

Activity 37
ENERGY SURVEY

MATHEMATICS

Objective: The student will read the electric meter, multiply the reading by 10, keep a daily reading log, calculate daily usage, and estimate a monthly bill. Skills developed include interpretation and evaluation of data.

Procedure:

A weekly analysis of the energy usage of the students' homes will be made. This will allow the student to study the energy usage of his family.

Resources:

1. Middle Tennessee Electric Cooperative, Lebanon, TN 37087.
2. Tennessee Energy Authority, 709 Capitol Boulevard Building, Nashville TN 37219.
3. U.S. Department of Energy, Washington, DC 20545.

Activity 38
WATTS TO KILOWATTS MATHEMATICS

Objective: To give students an opportunity to visualize the charge for different items and how that price is realized.

Procedure:

1. Have students convert amps x volts to watts.
2. Convert watts to kilowatts by dividing by 1000.
3. Multiply kilowatts by $ .04 to get a cost factor.

Resources:

1. Middle Tennessee Electric Cooperative, Lebanon, TN 37087.
2. Tennessee Energy Authority, 709 Capitol Boulevard Building, Nashville, TN 37219.
3. U.S. Department of Energy, Washington, DC 20545.

Activity 39
MATHEMATICS IN ENERGY

MATHEMATICS

Objective: Given watts, time of use, and price per kilowatt hour, the student will be able to compute the price of electrical usage.

Procedure:

1. Use three different sizes of light bulbs.
2. Have students find the location and identify the watts on each bulb.
3. Demonstrate the brightness of each bulb.
4. Explain the formula for finding cost:

$$\left(\frac{\text{watts x time in hours}}{1000}\right) \text{ cost per kilowatt}$$

4. Determine an average number of hours each bulb might be used in a month.
5. Display light with cost per month for operation.
6. List areas where lighting with low wattage bulbs is possible.

Resources:

1. Edison Electric Institute, 90 Park Avenue, New York, NY 10016.
2. Electric Energy Association, 90 Park Avenue, New York, NY 10016.
3. Electric Power Research Institute, 3412 Hillview Avenue, P. O. Box 10412, Palo Alto, CA 94309.
4. Tennessee Statewide Consumer Education Program, Environmental Center, University of Tennessee, South Stadium Hall, Knoxville, TN 37916.

Activity 40
COMPARING MILES PER GALLON

MATHEMATICS

Objective: Given simple data, the student will be able to make simple graphs and charts related to energy.

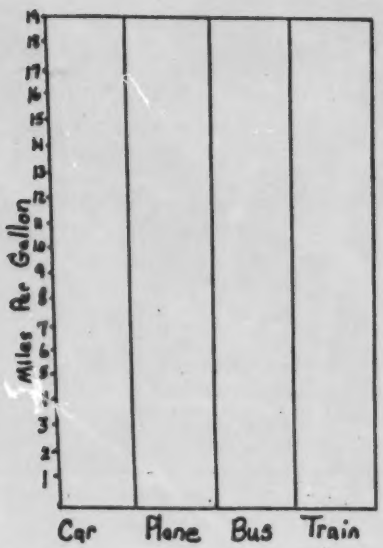
Procedure:

1. Explain miles per gallon.
2. List various means of transportation with average miles per gallon.
3. Chart information on a bar graph.
4. List different car models and manufacturer with MPG.
5. Have students pick out four dream cars.
6. Have students chart MPG for their dream cars.

See next page for example of activity.

Resources:

1. Fuel Economy, F.E.A., DPM Room 6500, Washington, DC 20461.
2. Gas Mileage Guide for New Car Buyers, U.S. Environmental Protection Agency, Pueblo, CO 81009.
3. U.S. Department of Energy, Technical Information Office, P. O. Box 62, Oak Ridge, TN 37830 (EDM - 1031 Transportation and the City).



Fill in the graph with this information

1. Car gets 18 miles per gallon.
2. Plane gets 1 mile per gallon.
3. Bus gets 4 miles per gallon.
4. Train gets $\frac{1}{2}$ mile per gallon.

Which one uses the most per mile?

_____

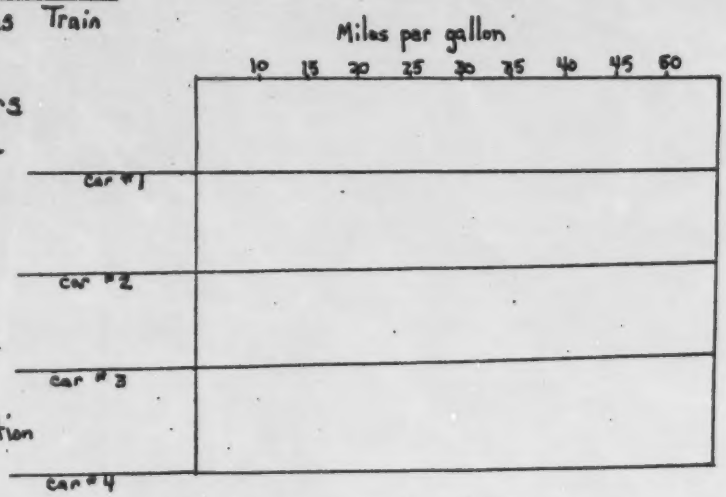
Which one uses the least?

_____

Pick out 4 cars you would like to own.

Find out how many miles per gallon each car gets.

Put your information on the graph.



Which one uses the most gas per mile? _____

Which one uses the least? _____

Model	Manufacturer	MPG
Chevette	GM-Chevrolet	36
Civic CVCC	Honda	44
Corolla Sedan	Toyota	32
Datsun B-210	Nissan	42
Datsun 200SX	Nissan	26
Accord CVCC	Honda	42
Celica GT	Toyota	26
Rabbit	Volkswagen	34
Fiat 128	Fiat	27
VW Station Wagon	Volkswagen	28
Opel (Isuzu)	Isuzu	27
Vega	GM-Chevrolet	28
Dodge Colt	Mitsubishi	35
Pinto	Ford	30
Mazda GLC	Toyo Kogyo	38
Mustang II	Ford	26
Datsun 280Z	Nissan	21
Volvo 244	Volvo	22
Gremlin	American Motors	23
Maverick	Ford	24
Volare	Chrysler-Plymouth	20
Nova	GM-Chevrolet	22
LTD II	Ford	17
GTO	GM-Pontiac	17
Trans Am	GM-Pontiac	17
Matador	American Motors	15
Cutlass Supreme	GM-Oldsmobile	18
Cougar	Ford	16
Ford	Ford	15
Buick Electra 225	GM-Buick	18
Plymouth	Chrysler-Plymouth	15
Silver Shadow	Rolls Royce	12
Chrysler	Chrysler-Plymouth	13
Bonneville	GM-Pontiac	17
Eldorado	GM-Cadillac	14
Buick Wagon	GM-Buick	18
Ford Wagon	Ford	13
Chrysler Wagon	Chrysler-Plymouth	12
Continental Mark V	Ford	13
Toronado	GM-Oldsmobile	15
Grand Prix	GM-Pontiac	17
Thunderbird	Ford	17
Mercedes 280 SE	Dailler-Benz	16
Seville	GM-Cadillac	16
Chevy Van V-8	GM-Chevrolet	18
Dodge Van V-8	Chrysler-Dodge	16
Ford Van V-8	Ford	16
VW Bus	Volkswagen	23

Activity 41
COMPARING FUEL SOURCES OF TODAY AND TOMORROW MATHEMATICS

Objective: Given a set of elements to 100, the student will be able to identify n/d of a set and to express n/d as meaning n of d equal parts as related to energy.

Procedure:

1. Discuss sources of fuel used today.
2. List amounts used today in parts per hundred rather than with a percent sign.
3. List amounts to be used in the future the same way.
4. Construct two grids with 100 squares each and have the students code each fuel source a different color.
5. Fill in the grid with symbols for each source. Use one grid for fuel today and the other for fuel in the future.
6. Express each fuel as a fractional part of the whole.
7. Discuss what changes we expect as fuel sources shift.

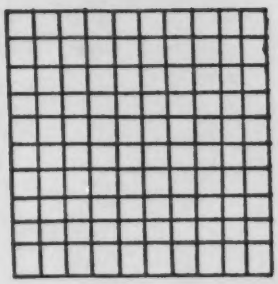
See next page for example of activity.

Resources:

1. Coal Mining Institute of America, 416 Ash Street, California, PA 15419.
2. National Energy Resources Organization, 821 15th Street, NW, Suite 636, Washington, DC 20005.
3. The Power of Coal. Education Division, National Coal Association, 1130 17th Street., NW, Washington, DC 20036.

(Over)

Fuel Today and Tomorrow



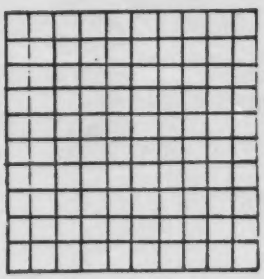
Where Our fuel comes from Today	fraction
Oil ■ Show 44 of 100 equal parts	____
Gas ▨ Show 31 of ___ equal parts	$\frac{31}{100}$
Coal ▩ Show ___ of 100 equal parts	$\frac{18}{100}$
Water ▧ Show 3 of 100 equal parts	____
Uranium ▥ Show 4 of 100 equal parts	____

Which fuel do we use the most of today? _____

Which fuel do we use the least of today? _____

Where Our fuel will come from Tomorrow

	fraction
Oil ■ Show 3 of 100 equal parts	____
Gas ▨ Show ___ of 100 equal parts	$\frac{4}{100}$
Coal ▩ Show 82 of ___ equal parts	$\frac{82}{100}$
Oil Shale ▣ Show ___ of 100 equal parts	$\frac{7}{100}$
Uranium ▥ Show 4 of 100 equal parts	____



Which fuel will we use the most of tomorrow? _____

Which fuel will we use the least of tomorrow? _____

Activity 42
HOW LONG MIGHT OUR OIL AND NATURAL GAS LAST? MATHEMATICS

Objective: Students will discover the limits of our supplies of oil and natural gas.

Procedure:

1. A mathematical exercise reveals the dramatic limits of U.S. supplies of oil and natural gas. Discuss with the class how they think these limits might affect their own lives and the life of the nation in years to come. Would conservation make a difference?

2. Some students may want to research and report to the class the uses of natural gas: important because it is easy to transport, nonpolluting, and energy-efficient. Natural gas is used in homes, shops, and factories to prepare food, to heat water and space, and to manufacture many industrial products. It is used as a raw material for fertilizer, and antifreeze, plastics, synthetic fibers, solvents, refrigerants, and other chemical compounds.

Resources:

1. The Energy Challenge. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

Activity 43
DECIMALS

MATHEMATICS

Objective: Students will be able to add, subtract, multiply and divide decimal fractions and write numbers in scientific notation as related to energy.

Procedure:

This lesson emphasizes adding, subtracting, multiplying and dividing decimal fractions and gives students practice in writing numerals in scientific notation.

Resources:

1. Holt Brothers Mathematics Series, Level 81-94.
2. U.S. Department of Energy, Washington, DC 20545.

Activity 44
PERCENTS

MATHEMATICS

Objective: Students will be able to solve for the unknown in a percent problem and compute the percent of increase and decrease as related to energy consumption.

Procedure:

1. In this lesson students review the three basic types of percent problems and learn how to solve for the unknown in a percent problem.

2. In addition, they will figure the percent of increase (or decrease) in a set of sample problems and then apply this computational skill to a series of energy related questions.

Resources:

1. Holt Brothers Mathematics Series Level 81-94.

2. Energy Conservation in the Home, U.S. Department of Energy, October 1977.

Activity 45
FRACTIONS

MATHEMATICS

Objective: Students will be able to compute what fractional part one number is of another, compute fractional parts of whole numbers, reduce fractions to lowest terms, express a problem as a proportion, and solve a proportion problem related to home energy.

Procedure:

Fractions are the topic of this skills activity. Students begin with a quick review of fractional parts of whole numbers and complete the lesson by solving a set of energy related problems involving proportions.

Resources:

1. American Home Economics Association, 2010 Massachusetts Avenue, NW, Washington, DC 20036.
2. Center for Energy Information, 340 East 51st Street, New York, NY 10022.
3. Owens-Corning Fiberglas Corporation, Fiberglas Tower, Toledo, Ohio 43659.

Activity 46
ENERGY AWARENESS

MATHEMATICS

Objective: Given a collection of coins (pennies, nickles, and dimes) the student will be able to identify the coins needed to total specific amounts less than $1.00 in relation to energy usage and costs.

Procedure:

1. Construct a game board with some spaces marked with red and green (approximately 1 of every 5 should be red or green).

2. List on green cards energy saving techniques and an amount of money that can be saved.

3. List on red cards things that waste energy and an amount that should be paid.

4. Students begin with 25¢ and move around the board from home to the bank. The student that reaches the bank with the most money wins. The student that wins must state two ways to save money and two ways that waste money to win.

5. As students move around the board students draw cards when they land on square of corresponding color and counts out money.

Resources:

1. Electric Savings, TVA Division of Energy Conservation, Phone: 1-800-362-9250.

2. Tennessee Statewide Consumer Education Program, Environment Center, University of Tennessee, South Stadium Hall, Knoxville, TN 37916.

Activity 47
IDENTIFICATION AND LOCATION OF NATIONAL PARKS MATHEMATICS

Objective: Given a numeral for a whole number to 100,000 the student will be able to identify the value for the place of each digit as related to energy and the environment.

Procedure:

1. Discuss the history of the national park system.
2. Organize students in groups to locate on a map of the U.S. the national parks.
3. Help students list reasons for maintaining a national park system.
4. List national park areas by acreage from the smallest to the largest.
5. Express the land area of each park in expanded form.

Resources:

1. The Garden Club of America, 598 Madison Avenue, New York, NY 10022.
2. National Parks and Conservation Association, 1701 18th Street, NW, Washington, DC 20009.
3. National Recreation and Parks Association, 1601 North Kent Street, Arlington, VA 22209.

MUSIC

Activity 48
MAKE MUSIC WITH YOUR GARBAGE

MUSIC

Objective: To make musical instruments and save energy by recycling garbage.

Procedure:

1. Ask students to bring from home yesterday's garbage.
2. Listed below are several activities to create musical instruments from garbage.
   (a) Using wasted paper towels from the lavoratory or newspspers, one can make papier-mache. If light globes are in your garbage they make excellent maracas after being papier-mached and then broken.
   (b) Coffee can bongos.
   (c) Can lid cymbals (make sure sharp edges are covered with tape.
   (d) Musical bottles (put different amounts of water into bottles - hit with mallet to produce different sounds).

Resources:

1. Lund, Cherie and Chanelle Wolfe. Exploration with Garbage. Project Ecology. Highline Public Schools, Seattle, WA. Title III, ESEA. ERIC Document No. ED 132 008.
2. Newman, Grant. Teaching Children Music Fundamentals of Music and Method. Dubuque, Iowa, William C. Brown Co., 1979.
3. Roukes, Nicholes. Classroom Craft Manual. Belmont, CA, Fearon Publishers, Inc., MCMLX.

Activity 49
STEAM IS A SOURCE OF ENERGY

MUSIC

Objective: To provide students an opportunity to understand that steam is a way to produce energy.

Procedure:

This activity will let students illustrate an elementary song to get across the idea of what steam can do.

1. Have a hot plate on hand on this day. Bring a teapot and set it on the hot plate to boil.

2. While the children are observing the tea-pot ask them some questions. What do you hear? What do we see coming out at the top of the tea-pot? (steam) What happened to the lid? (blew off)

3. With the experiment of the tea-pot in mind sing the song "I'm a Little Teapot" with the children.

4. What can we say about the tea-pot? What made the lid blow off? Then discuss how steam plants turn it into electricity.

Resources:

1. National Association of Electric Companies, 1140 Connecticut Avenue, NW, Washington, DC 20036.

2. Steiner, Violette G. and Roberta Evatt Pond. Finger Play Fun. Columbus, OH, Charles E. Merrill Publishing Company, 1970.

3. Tennessee Valley Authority, 400 Commerce Avenue, Knoxville, TN 37902.

Activity 50
MANPOWER A SOURCE OF ENERGY

MUSIC

Objective: To provide students an opportunity to learn that their own energy (manpower) is a source of energy.

Procedure:

This activity will let students illustrate an idea of what manpower really is through a song. Students should understand that they can use their energy to get a job done. To make them realize they don't always have to rely on machines to do the work for them.

1. Talk about and list the many ways that their energy can make things move. Talk about ways of getting somewhere other than by car.

2. Ask them if they have bicycles? If they do, do they let them take them places instead of their cars? Talk about what happens when they pedal fast or slow.

3. Then discuss how their body feels after they have ridden their bikes. Discuss how we get our energy.

4. Then sing with them the "Pedal Song" (to the tune of "Little Brown Jug").

My bicycle is a trusty friend
I pedal and pedal without end
Sometimes fast and sometimes slow
On my errand I can go.

For my mother or a friend
I pedal to the grocery store
Sometimes I pedal just for fun
Faster than a child can run.

Resources:

1. The Bicycle Institute of America, Inc., 122 East 42nd Street, New York, NY 10017.

2. Energy in the Classroom - Activity Guide for K-3. Virginia Energy Office 823 East Main Street, Richmond, VA 23219, 1975.

3. Steiner, Violette G. and Roberta Evatt Pond. Finger Play Fun. Columbus, OH, Charles E. Merrill Publishing Company, 1970.

Activity 51
LET'S WRITE A SONG ABOUT ENERGY

MUSIC

Objective: To compose a song about energy using a familiar tune or to create a "new" tune.

Procedure:

1. Discuss with students the ideas and things about energy that they feel should be included in their song.

2. Divide the students into groups and have them compose several of these ideas into poems or stanzas.

3. Decide upon a familiar tune that all students know and begin to fit the words to the music.

4. If creativity abounds attempt to completely write and compose a new "hit."

Resources:

1. Moore, Karen. Note - A Handbook of Classroom Ideas to Motivate the Teaching of Elementary Music. Stevensville, MI, Educational Services Inc., 1973.

2. Newman, Grant. Teaching Children Music Fundamentals of Music and Method. Dubuque, IA, William C. Brown, Co., 1979.

SCIENCE

Activity 52
ENERGY CONSERVATION

SCIENCE

Objective: To help students gain an awareness of energy usage and conservation in the home.

Procedure:

1. Have students use the "Energy Savings Fun" from Tennessee Energy Authority prepared for this activity to determine where/why/how energy is wasted. Information collected from responses on the checklists can be used by students to develop energy conservation suggestions for their parents. Students will encourage their families to implement the energy conservation steps and do their part to make it work.

2. Following this experience, the class might discuss such questions as:

   (a) What are the most inexpensive ways to conserve energy in the home?

   (b) What are the most effective ways to conserve energy in the home?

   (c) Does insulation help in the conservation of energy?

   (d) Is it cheaper to save a barrel of oil than to produce an additional barrel?

   (e) Is your house drafty?

   (f) Is your school wasting heat?

   (g) What color holds heat longest?

Resources:

1. American Museum of Science and Energy, Education Division, Office of Consumer Affairs, Washington, DC 20585.

2. Conservation Society of America, 7515 Northeast Ankeny Road, Akeny, IA 50021.

3. Science Energy Workshop, Scholastic News Citizen, Vol. 49, No. 15, Feb. 1981.

4. Public Affairs Department, Exxon USA, P. O. Box 2180, Houston, TX 77001.

5. Tennessee Energy Authority, 709 Capitol Boulevard Building, Nashville, TN 37219.

6. U.S. Department of Energy, Education Division, Office of Consumer Affairs, Washington, DC 20585.

7. U.S. Department of Energy, Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830.

Activity 53
ENERGY CLASSIFICATION

SCIENCE

Objective: Students will be able to categorize and explain how various projects are using energy and what sources of energy is being used.

Procedure:

1. Choose ten energy projects (uses of energy or sources of energy) and categorize them into what specific kind of energy they are dealing with.

2. Using the child's own opinion, let him categorize the same ten projects from the most desirable energy source for the future to the least desirable energy source for the future. Let each child share his list with the class and explain why he chose the order of energy sources.

3. Let each child choose two examples each of energy moving, heating, and lighting things.

Resources:

1. Center for Energy Information, 340 East 51st Street, New York, NY 10022.

2. Center for Environmental Education, 1621 Connecticut Avenue, NW, Washington, DC 20009.

Activity 54
AIR PRESSURE

SCIENCE

Objective: To show how hot air rises and cold air contracts.

Procedure:

1. Gather materials needed: bottle, balloon, pan, water, heat source, ice.

2. Put the balloon over the top of the bottle. Place the bottle in the pan of water. Put the pan on the heat source so the water can heat. As the water gets hotter the balloon will begin to blow up.

3. When the balloon rises to an acknowledgeable size, take the bottle with the raised balloon and set in in ice. As the air in the bottle cools the balloon will contract.

4. Discuss how this would compare to the heat in your home.

Resources:

1. Blecha, Milo K., Herbert Pless, Herbert A. Smith. Modern Science. Laidlaw Brothers, Atlanta, GA, 1974.

2. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

3. Other physical science textbooks.

Activity 55
WHAT IS THE BEST INSULATING MATERIAL? SCIENCE

Objective: To show students that something can be done to hold heat in a structure.

Procedure:

1. Collect materials needed: cardboard box, knife, tape, 4 thermometers, 4 kinds of insulation, paper, foil, cloth, etc., 100 watt bulb in ceramic socket, clock.
2. Keep the top of the box sealed and let the bottom open up. Cut large windows in each side of the box.
3. Tape a different kind of insulation in each window.
4. Tape a thermometer on the outside of each insulated window.
5. Place the light inside the box.
6. Record the temperature of each thermometer. Turn the light on and after 10 minutes record the temperature again.
7. Explain the lowest reading shows that the insulation let less heat out. Discuss how layers of the best insulation could help retain heat in the home.

Resources:

1. National Insulation Contractors Association, 8630 Fenton Street, Suite 506, Silver Springs, MD 20910.
2. Owens-Corning Fiberglas Corporation, Fiberglas Tower, Toledo, OH 43659.
3. Science Activities in Energy. U.S. Department of Energy. write: Oak Ridge Associated Universities, American Museum of Atomic Energy, P. O. Box 117, Oak Ridge, TN 37830.

Activity 56
WHAT REALLY IS ROOM TEMPERATURE? SCIENCE

Objective: To show the differences in temperatures within a room.

Procedure:

1. Place thermometers at different locations throughout the room (ceiling, floor, window, door, inside wall, outside wall).

4. Take readings at 4 different times during the day.

5. Discuss why the room was warmer in places during different times of the day.

6. Discuss the greenhouse effect during sunny hours and heat loss when the sun is away from the windows.

7. Compare ceiling and floor temperatures and discuss the rising of heat concept.

8. Have students measure, record and analyze the data.

Resources:

1. How We Make Energy Work. U.S. Department of Energy. write: Oak Ridge Associated Universities, American Museum of Atomic Energy, P. O. Box 117, Oak Ridge, TN 37830.

2. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

Activity 57
AIR CIRCULATION AND TEMPERATURE SCIENCE

Objective: To show how ventilation can cool a house.

Procedure:

1. Gather materials needed: cardboard box, thermometer, knife, light bulb in a ceramic socket.
2. Cut a window flap in the top of one side of the house. Cut another flap in the lower part of the same side. Close both flaps.
3. Record the temperature every minute up to 5 minutes.
4. Next, open the top flap and record the temperature every minute for 5 minutes.
5. Do the same thing again, but only open the bottom flap.
6. Last, open both flaps and record the temperature every minute for 5 minutes.
7. Discuss how excessively opening doors in winter would affect the heating of a house. Also discuss ventilation for summer time.

Resources:

1. Science Activities in Energy. U.S. Department of Energy. Write: Oak Ridge Associated Universities, American Museum of Atomic Energy, P. O. Box 117, Oak Ridge, TN 37830.
2. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

Activity 58
HOW TO INSULATE AN ICE CUBE

SCIENCE

Objective: To help students become familiar with the types of insulation available, their uses, advantages, disadvantages, and costs.

Procedure:

1. Divide students into groups of four.

2. Give each group ice cubes, plastic bags, and insulating materials, and challenge them to insulate the ice cubes for the longest possible time. Materials may include such things as paper of various thickness, cardboard, styrofoam cups, aluminum foil, glass cups, metal cups, plastic containers, wax paper, newspaper, foam rubber, vermiculite, sand, small wooden containers, cotton balls, and different cloth materials.

3. Place an ice cube in a plastic container to use as a timer. When it's almost melted, it's time to check all the ice cubes and compare the results.

4. While waiting for melting ice cubes, display different types of insulation and have students discuss where such insulation should be used in our homes.

5. Explain the importance of R-value, a number which tells how much heat resistance insulation possesses. The average is R-19 for ceilings and R-11 for walls and floors. The higher the R-value the better.

6. Types of insulation include batts, blankets, rigid board (urethane board or glass fiber), and loose fill (blown in) such as glass fiber, rock wool, or cellulosic fiber. As a follow-up assignment, ask students to consult various dealers and find the relative cost of each type.

Resources:

1. Energy Activities: A Station Approach. Tennessee Valley Authority, Environmental Education Specialist, Environmental/Energy Education Program, Division of Land and Forest Resources, Norris, TN 37828.

2. Energy Activity Guide. National Recreation and Park Association.

3. Insulation. U.S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37830. (Fact Sheet)

Activity 59
FRICTION'S EFFECT ON DISTANCE

SCIENCE

Objective: To test the effects of air pressure in bike tires in regard to energy usage.

Procedure:

1. Because friction makes machines harder to move, bikes (and cars) require more energy to move if their tires are soft than if they are properly inflated. Demonstrate this phenomenon to your students as follows.

2. Ask two students with similar type bikes and of similar weight to bring their bikes to school. Inflate one bicycle's tires to normal pressure and the other's to half that amount.

3. Have students ride side by side at the same speed. When they reach a selected line on the ground, they should coast the rest of the way.

4. Compare how far each goes. Is it important to check tire pressure on your bicycle? What about your family car?

5. This activity can be used as an energy fair exhibit showing results of varying tire pressure in comparison to recommended pressure. A demonstration area could also be set up to let people try for themselves.

Resources:

1. American Automobile Association, 8111 Gatehouse Road, Falls Church, VA 20042.

2. The Ford Foundation, Energy Policy Project, P. O. Box 23212, Washington, DC 20024.

3. Science Activities in Energy - Conservation. The American Museum of Atomic Energy, Oak Ridge Associated Universities, P. O. Box 117, Oak Ridge, TN 37830.

4. Texaco, Inc., 135 East 42nd Street, New York, NY 10017.

Activity 60
SOLAR ENERGY

SCIENCE

Objective: To help the student gain an understanding of solar energy - and that we can use collectors to concentrate the energy.

Procedure:

1. Students will learn that the sun is a primary source of energy for all plants on the earth. Plants use energy from the sun to combine minerals from the soil with carbon dioxide from the air to make starches and sugar. This process is called photosynthesis.

2. Students will learn that today we can collect the sun's energy in photocells or in glass covered boxes which are blackened inside. The photocells convert the sun's energy to electricity. The energy absorbed in the glass covered boxes (which are called "solar panels") can be used to heat water flowing over them in pipes or tubes. This hot water can then be stored for use, or used to heat a home.

3. Facts:

   The sun gives light.

   The sun gives heat.

   Plants need sunlight in order to grow healthily.

   Boys and girls need sunlight.

4. Name some direct and indirect uses of solar energy.

Resources:

1. Energy: What About the Future? Department of Energy, Washington, DC 20585.

2. How We Make Energy Work. Grades 4, 5, 6 Science, U.S. Department of Energy, Office of Consumer Affairs, Washington, DC 20585.

3. The Mini Page - Our Many Energy Sources. Supplement to the Herald Citizen newspaper, Sunday, March 9, 1981.

4. Solar Energy, Environmental/Energy Education Program. Division of Land and Forest Resources, Tennessee Valley Authority, Norris, TN 37828.

5. Solar Energy, Science Activities in Energy. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

6. Solar Energy II, Science Activities in Energy. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

(Over)

7. Science Corner, Instructional TV - WCTE-TV. Tuesdays at 1:30 p.m., Cookeville, TN.

8. Weekly Reader. Edition 5, Issue 14, Vol. 59, January 16, 1981.

Activity 61
CAN WE STORE SOLAR ENERGY? SCIENCE

Objective: To demonstrate how to store solar energy and test various materials to determine which stores solar energy the best.

Procedure:

1. Collect materials needed: cardboard box, black paint, 4 small metal cans, 4 thermometers, sand, salt, water, and torn up paper.
2. One of the biggest problems of making widespread use of solar energy is finding ways to store it when the sun is not present. The following experiment gives a clue as to how such storage is accomplished.
3. Fill one metal can with sand, one with salt, one with water, and one with torn up paper and place a thermometer in each can.
4. Paint the cardboard box black, and put the cans in the box.
5. Place the closed box in the sun for one-half hour.
6. Remove the cans and watch the temperature fall.
7. Stir contents occasionally.
8. Which temperature falls the slowest? Which stores solar heat the best?

Resources:

1. National Insulation Contractors Association, 8630 Fenton Street, Suite 506, Silver Springs, MD 20910.
2. Owens-Corning Fiberglas Corporation, Fiberglas Tower, Toledo, OH 43659.
3. Solar Energy, Science Activities in Energy. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.
4. Thermal Insulation Manufacturers Association, Inc., 7 Kirby Place, Mt. Kisco, NY 10549.

Activity 62
SOLAR WATER HEATER

SCIENCE

Objective: To show how the sun can heat water.

Procedure:

1. Gather materials needed: box, clear tube, plastic, black paint, cup, thermometer, tape, knife, clock, water.
2. Cut the top off the box.
3. Paint the box black, inside and out.
4. Cut a hole at the top of the left side of the box and run the tube through. Put another hole in the bottom of the right side of the box for the end of the tube to come out.
5. Cover the front of the box with plastic.
6. Take the box outside, take the temperature of the water before you pour it in. Pour the water in the tube and do not allow it to run out. Let the box sit facing the sun for 10 minutes.
7. After 10 minutes, let the water out in a cup and take the temperature.
8. Note the difference in the beginning temperature and the ending temperature.
9. Discuss what part the plastic played in the experiment. Talk about ways this concept could be used on a larger scale (solar heating, solar water heating).

Resources:

1. Science Activities in Energy. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830
2. Solar Energy Industries Association, 1001 Connecticut Avenue, NW, Suite 632 Washington, DC 20036.
3. Solar Energy Society of America, P. O. Box 4264, Torrance, CA 90510.

Activity 63
CONCENTRATED ENERGY

SCIENCE

Objective: To demonstrate that the winter sunlight can be hot when concentrated.

Procedure:

1. Explain to your students that all of the earth's energy originally comes from the sun. Some might believe that winter sun is not hot, particularly in colder climates. This activity demonstrates that even the winter sunlight can be concentrated into a source of much heat.

2. Saw a small tree or branch with bark into 1/4 to 1/2 inch thick pieces, one for each child in the class.

3. Drill a hole for a leather shoe lace and make a pendant.

4. Ask students to write or print their names on the wool using a heavy lead pencil.

5. Pick a sunny day to take your class outdoors.

6. Show the students how to use a magnifying glass to concentrate the sun's rays onto the writing on the pendant. The dark graphite absorbs more of the sun's energy and will burn the imprint into the wood.

7. After the names are burned into the wood, spray each pendant heavily with acrylic spray and hang overnight to dry.

Resources:

1. Hotze, Beverly, Elementary School Teacher, Mark Twain Elementary School, Westerville, Ohio.

2. Tennessee Energy Authority, 709 Capitol Boulevard Building, Nashville, TN 37219.

3. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

4. Solar Energy Society of America, P. O. Box 4264, Torrance, CA 90510.

Activity 64
SOLAR ENERGY PRODUCES SUGAR IN PLANTS SCIENCE

Objective: To show students how the sun produces sugar in plants.

Procedure:

1. Collect materials: coleus or geranium plant, black construction paper, paper clips, iodine.

2. Select a leaf from the plant.

3. Cut two pieces of black construction paper slightly larger than the leaf. Using paper clips, fasten the two pieces of paper, sandwich style, to a leaf on the plant. The leaf should be between the papers.

4. Place the plant in a sunny window.

5. After several days remove the papers and put three drops of iodine on this leaf and also on a leaf that was not covered. The exposed leaf on the iodine will turn bluish-black, but the leaf which was covered will show no change. When the iodine reacts with the starch it produces a bluish-black color. Therefore, the color change you saw indicated starch was present. But the covered leaf contained no starch because it had been shielded from the sunlight.

Resources:

1. Ashley, Tracy H. Science Comes to Life. Darien, CT, Teacher Publishing Company, 1961.

2. Life Science textbooks.

3. New York State College of Agriculture and Life Sciences, Department of Natural Resources, Cornell University, Ithaca, NY 14850.

4. Science Activities in Energy: Chemical Energy, U.S. Department of Energy Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

5. Solar Energy Society of America, P. O. Box 5264, Torrance, CA 90510.

Activity 65
STATIC ELECTRICITY

SCIENCE

Objective: To show students how electrical charges can be produced by friction.

Procedure:

1. Collect materials: wool cloth, rubber comb, rubber balloons, silk cloth, tiny bits of paper, sawdust, sand, iron filings, pith balls, newspaper, glass bottles, paper and string.

2. Rub a comb briskly with the wool cloth. Bring the comb close to the pieces of paper, sawdust, sand, iron filings. What happened?

3. Hold a sheet of paper against the blackboard. Rub it rapidly with a pencil. Remove your hand. What does the paper do?

4. Blow up a balloon. Tie its mouth. Rub the balloon with a wool cloth. Hold the balloon near the wall. What happens?

5. Hold a comb that has been rubbed with a wool cloth near the balloon that has been rubbed with a wool cloth. What happens?

6. Blow up another balloon. Tie each balloon to a piece of string about three feet long. Rub one balloon with a piece of wool cloth. Hold it by the string and bring it near the other balloon which is held by the string. What happens?

7. Rub both ballons with the wool cloth. Hold the balloons by the strings and bring them near each other. What happens?

8. Tear a strip of newspaper about two inches wide and about two feet long. Fold the paper in the middle and hold between the fingers of one hand. With the other hand grasp the paper between the first and second fingers and pull down rapidly several times. What do the strips of paper do?

9. Rub a glass bottle with a silk cloth. Hold the bottle near bits of paper, sawdust, sand and iron filings. What happened?

10. Rub the glass bottle with the silk cloth. Rub the balloon with the wool cloth. Bring the bottle near the balloon. What happens?

    Remember what happended in number 5 when the comb was brought near the balloon. The bottle has a different electrical charge from that of the balloon.

10. Charge a strip of newspaper as in number 8. Hold the paper in one hand as before. Place a comb rubbed with wool beneath the paper. What does the paper do? Place a bottle that has been rubbed with silk beneath the papers. What happens?

(Over)

Resources:

1. Ashley, Tracy H. Science Comes to Life. Darien, CT, Teacher Publishing Company, 1961.

2. Heimler, Charles H. and Jack Price. Focus on Physical Science. Columbus, OH, Charles E. Merrill Publishing Co., 1969.

3. Other Physical Science Textbooks.

4. Tracy, George R., Harry E. Tropp, and Alfred E. Friedl. Modern Physical Science. New York, Holt Rinehart and Winston, Inc.

Activity 66
CENERATING ELECTRICITY USING A BICYCLE WHEEL SCIENCE

Objective: To demonstrate to students how a light bulb can be lighted by peddling a bicycle.

Procedures:

1. Collect materials: bicycle, small D.C. motor, flashlight lamp, copper wire for connectors, masking tape.

2. Build up the motor shaft with masking tape to about 1/2 cm. in diameter.

3. Turn the bike upside down so you can turn the pedals with your hand. Hold the motor shaft so it just touches. See what happens. Does the fastness of the wheel effect the brightness of the bulb? Let the students make the wheel turn so they can see how much effort it takes to make it light up. What would happen if you used two generators? You can also try different light bulbs.

Resources

1. Ashley, Tracy H. Science Comes to Life. Darien, CT, Teacher Publishing Company, 1961.

2. Electrical Energy: Science Activities in Energy. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

3. Tennessee Valley Authority, 400 Commerce Avenue, Knoxville, TN 37902.

Activity 17
PRIMARY ENERGY SOURCES

SCIENCE

Objective: Students will be able to recognize the difference between a primary source of energy and a secondary source such as electricity, and the distinction between a primary energy source and the production of electricity.

Procedure:

1. The diagram on this activity master shows six primary energy sources and the work that each one does today. Your students' experience with the timeline should make it easy for them to say that wood is now rarely used as an important energy source. You might want to ask students to look on their timelines to see how long wood lasted as a major source of energy for home use. Ask if they use any wood in their homes today. Discuss reasons why wood is no longer an important energy resource; then point out that some of the energy sources we use today may one day become as insignificant as wood.

2. Both the timeline and the primary energy source diagram will help students complete the story about the Spritz family and its use of energy. Some questions may require combining several bits of information from both references to arrive at an answer. For example, it is more likely that the locomotive that took Great Grandmother and Great Grandfather Spritz on a honeymoon in 1901 would have burned coal, not wood.

Resources:

1. The Energy Challenge. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

Activity 68
ENERGY SOURCES

SCIENCE

Objective: Children will be able to understand what it means when we say energy, talk about sources of energy, identify the 3 fossil fuels (coal, oil and natural gas), demonstrate how fossil fuels were formed, and recognize that, when used up, fossil fuels are completely gone.

Procedure:

1. Let children write an essay explaining what energy means to them. Use these papers to lead into class discussion of what is meant when people talk about using energy.

2. Have children do research to find some sources of energy. Let the class create a mural showing the various sources of energy. This mural could be displayed in a hallway for other classes to view.

3. Help the children come to the conclusion that more of our energy comes from the use of fossil fuels. Have the class demonstrate how we use these fossil fuels. This can be shown by having posters made from pictures cut from magazines and newspapers and pasted to poster boards.

4. Divide the class into groups and let each group choose one of the three fossil fuels to use as the subject of a mural. They should show how the particular fuel was formed many years ago. Encourage reports (written and oral) about the fossil fuels.

5. Place two crackers in a plastic bag. Let the class examine the crackers. Then have a number of children eat up the crackers. Look again at the plastic bag. All the crackers which were in the bag are gone. Those two crackers are gone forever. Use this to help children understand that fossil fuels are non-renewable resources.

Resources:

1. National Coal Association, 1130 17th Street, NW, Washington, DC 20036.

2. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

3. U.S. Environmental Protection Agency, Washington, DC 20460.

Activity 69
THE COAL SITUATION

SCIENCE

Objective: To help students develop an understanding of coal use and availability in Tennessee, the nation, and world.

Procedure:

Have students conduct library research and contact organizations to learn more about the production, use, and future of coal. Specifically, students should obtain answers to the following questions:

1. Why is coal referred to as a "fossil fuel?"
2. Where are coal reserves found in Tennessee? In the nation? In other countries?
3. What percent of the total energy used in the United States is supplied by coal?
4. What is coal used for?
5. At present consumption rates, how long would known reserves of coal in the United States last?
6. To what extent do we export coal from the United States to other countries? Do we import any coal?
7. How is coal normally mined, stored, and transported?
8. Is it cheaper to strip-mine or deep-mine coal? What are the differences in these two mining methods?
9. What role does the Tennessee Department of Conservation have in coal mining? Are its policies effective? What else could/should the Department do?
10. How is strip-mined land reclaimed?
11. What role does TVA play in strip-mine reclamation? Are its policies effective? What else could/should TVA do?
12. What are the different kinds of coal and which is highest in sulfur content? What difference does this make?
13. What are the environmental and economic advantages and disadvantages of burning coal?
14. What are some of the kinds of pollution control devices used when burning coal? What kinds are more effective? Are they expensive? Explain.

(Over)

15. What are the advantages of building coal-fired steam plants close to coal reserves or mines?

Resources:

1. Energy Research and Development Administration, 20 Massachusetts Avenue, NW, Washington, DC 20545.

2. Films: Coal - Taking the Lumps Out and Coal - The Other Energy, Department of Energy Film Library, P. O. Box 62, Oak Ridge, TN 37830.

3. The Power of Coal, National Coal Association, 1130 Seventeenth Street, Washington, DC 20036.

4. Tennessee Department of Conservation, 2611 West End Avenue, Nashville, TN 37203.

5. Tennessee Valley Authority, 400 Commerce Avenue, Knoxville, TN 37902.

Activity 70
COAL AS A NATURAL RESOURCE

SCIENCE

Objective: To draw attention to coal as a natural resource in the U.S.

Procedure:

1. As an opening demonstration, grow a coal plant using the recipe as follows:

   6-8 pieces of coal in a bowl
   2 tablespoons of salt
   1/2 ounce laundry bluing
   3 tablespoons ammonia
   1/2 cup water
   3 tablespoons red ink
   Combine all and let sit without stirring for several days.

2. Compare cost of heating with coal to electric and natural gas costs.

3. Use booklet "The Power of Coal" with its worksheets for students available from the National Coal Association (see address below).

Resources:

1. Coal Mining Institute of America, 416 Ash Street, California, PA 15419.

2. National Coal Association, Education Division, 1130 17th Street, NW, Washington, DC 20036.

Activity 71
THE NATURAL GAS SITUATION

SCIENCE

Objective: To help students develop an understanding of natural gas in Tennessee, the nation, and the world.

Procedure:

Have students conduct library research and contact organizations to learn more about the availability, use, and future of natural gas. Specifically, students should obtain answers to the following questions:

1. Why is natural gas referred to as a "fossil fuel?"
2. Where are natural gas reserves found in the nation? In other countries?
3. How is natural gas obtained, stored, and transported?
4. What are the major uses of natural gas?
5. What are the advantages and disadvantages of burning natural gas?
6. What percent of the total energy used in the United States is supplied by natural gas?
7. At present consumption rates, how long will known reserves of natural gas in the United States last?
8. Which economic sector (residential, commercial, industrial, agricultural, transportation) should be given priority for using natural gas as reserves become depleted? Why?
9. How does government or industry know where natural gas shortages will take place? What special problems do we face in Tennessee.
10. What are the kinds of problems an industry will face if it must substitute another fuel for natural gas? For example, what would happen if all the industries in Tennessee which use natural gas had to switch to coal or oil?
11. What does the future look like for use of liquefied natural gas? For coal gasification?
12. Has natural gas been cheap or expensive in the past?
13. What federal agency regulates the price of natural gas?
14. What are the most important ways to conserve natural gas?

(Over)

Resources:

1. American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209. The Story of Natural Gas Energy and Experiments: Properties of Gas and Heat Energy.

2. Energy Research and Development Administration, 20 Massachusetts Avenue, NW, Washington, DC 20545.

3. Federal Energy Administration, 12th and Pennsylvania Avenue, NW, Washington, DC 20461.

4. Federal Power Commission, 825 North Capitol Street, NE, Washington, DC 20426.

4. Tennessee Public Service Commission, Cordell Hull Building, Nashville, TN 37219.

5. Tennessee Energy Authority, 709 Capitol Boulevard Building, Nashville, TN 37219.

Activity 72
OIL - HOW FAST DOES IT FLOW?

SCIENCE

Objective: To determine the viscosity of various oils.

Procedure:

1. Collect materials needed: large tin can and a small tin can, a small stand to support small can fashioned from empty milk carton, scissors, various oils (#40 oil-heavy, #20 oil-light, vegetable oil, baby oil, etc., and a watch with a second hand.

2. Put a hole in the bottom of the juice can at least 3 mm in diameter. Cut a hole in the stand, large enough for the oil to pass through but small enough to support the can. Place the large can beneath the hole to catch oil as it runs through the openings.

3. Fill the small can 1/2 full of one of the various oils, and time it as it runs out. Clean the can and repeat with each of the different oils. Compare the results by graphing data obtained.

Resources:

1. Chemical Energy: Science Activities in Energy. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

2. Mobil Oil Corporation, 150 East 42nd Street, New York, NY 10017.

3. Petroleum Industry Research Foundation, 122 East 42nd Street, New York, NY 10017.

4. Phillips Petroleum Company, 4A4 Phillips Building, Bartlesville OK 74003.

5. Texaco, Inc., 135 East 42nd Street, New York, NY 10017.

Activity 73
SAVE ENERGY - USE OIL TO REDUCE FRICTION SCIENCE

Objective: To determine the degree of friction reduction with various oils.

Procedure:

1. Collect materials needed: #40 oil, #10 oil, edible oil, paper towels, 4 pieces of wood (25 cm long x 8 cm wide x 2 cm thick with one side smooth), protractor, 4 blocks of wood (6 cm x 6 cm x 4 cm - edges should be saw cut, not sanded).

2. Coat one side of the boards and blocks with very thin layers of oil. Rub them down with paper towels. Don't leave excess oil on them.

3. Raise the boards to make inclined planes. Drop the block gently onto the board at bigger and bigger angles until it slides quickly downhill. Record the angle of each board at which the block slides best.

4. Evaluate which oil reduces friction, but at each recorded angle. Graph.

Resources:

1. Chemical Energy: Science Activities in Energy. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

2. Exxon Corporation, 1251 Avenue of the Americas, New York, NY 10020.

3. Mobil Oil Corporation, 150 East 42nd Street, New York, NY 10017.

4. Petroleum Industry Research Foundation, 122 East 42nd Street, New York, NY 10017.

Activity 74
OIL SHALE

SCIENCE

Objective: To demonstrate the production of oil from a sample of Chattanooga Shale.

Procedure:

1. Collect materials needed: test tube, test tube clamp, burner (burner or alchohol), matches and several samples of oil shale.

2. Collect several samples of oil shale and grind into small pieces.

3. Place several pieces into a test tube and heat under a hood or in area where there is plenty of ventilation.

4. As oil begins to collect, observe smoke and odor. Pour oil into small container for future observation or use.

4. One may wish to use the collected oil in activities describing flow rates and reduction of friction.

Resources:

1. Oil Shale. Channing L. Bete Co., Inc., 45 Federal Street, Greenfield, MA 01301.

2. Oil Shale - A Potential Source of Energy. U.S. Department of the Interior, Geological Survey, USGS: Inf. - 71-13 (R3), Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

3. Supplementary Energy Sources. American Petroleum Institute, Publications and Distribution Section, 2101 L Street, NW, Washington, DC 20037.

Activity 75
THE NUCLEAR REACTOR

SCIENCE

Objective: To help students develop an understanding of the nuclear reactor and its potential for producing electricity.

Procedure:

Have students conduct library research and contact organizations to learn about the operation of a nuclear reactor and its potential use in the future. Students should obtain answers to the following questions.

1. What are the components of the nuclear reactor system? How does the system operate?
2. How efficient is the nuclear power plant in comparison to the fossil-fueled plant?
3. Does nuclear energy compete economically with other forms of energy?
4. What are the most serious dangers involved in the production of nuclear energy?
5. What are the major kinds of safety systems built into the nuclear power plant?
6. What is the "emergency core cooling system" in a nuclear reactor?
7. How is radioactive waste transported, stored, and disposed of?
8. How do thermal discharges from the nuclear plant affect the life cycles of aquatic plant and animal life?
9. Can we afford to bypass the construction of more nuclear plants for cleaner and safer means of generating electric power? If so, what are the best alternatives to nuclear power?
10. What agency approves the licensing of a nuclear power plant?
11. How many nuclear power plants does TVA now have under construction in Tennessee? Where are these plants located? How many plants does TVA plan to build during the next 10 years? Where will these plants be located?
12. What criteria does TVA use to select sites for nuclear plants?
13. What is a nuclear park?
14. What is the Price-Anderson Act? Explain.
15. Where are known reserves of uranium located in the United States? In other countries? How long would uranium reserves in the United States

(Over)

last based on present consumption rates? Could the breeder reactor greatly extend uranium supplies? If so, how? To what extent does the United States sell uranium to foreign countries? Why is this done? Does the United States import uranium?

16. What is a nuclear reprocessing plant and how does it function?

Resources:

1. Clinch River Breeder Reactor Plant Project, P. O. Box U, Oak Ridge, TN 37830.

2. Energy Research and Development Administration, 20 Massachusetts Avenue, NW, Washington, DC 20545.

3. Nuclear Power Information. Atomic Industrial Forum, Inc., 7101 Wisconsin Avenue, Washington, DC 20014.

4. Nuclear Regulatory Commission, Washington, DC 20555.

5. Tennessee Environmental Council, P. O. Box 1422, Nashville, TN 37202.

6. Tennessee Valley Authority, 400 Commerce Avenue, Knoxville, TN 37902.

Activity 76
ENERGY FLOW

SCIENCE

Objective: To help students understand how energy from food is used, transferred, and lost.

Procedure:

1. Discuss with students such terms as: food chain, producer, consumer, decomposer, respiration, biomass, trophic level, food pyramid, and calorie.

2. Students should know that chemical energy available in life processes is constantly decreasing through the food chain.

Students should:

1. be able to construct a simple food chain and describe how energy is passed along it.

2. know the extent to which green plants absorb the sun's energy.

3. know the calories contained in some of the more common foods.

4. know how energy is dissipated to maintain body metabolism.

5. know how man, through agricultural processing of foods, loses or wastes significant amounts of energy.

6. know what condition our environment is in.

7. know how they can make our environment a better place in which to live.

8. know why protecting the environments protects humans.

Resources:

1. As You Live You Breathe. American Lung Association, 1717 West End Avenue, P. O. Box 399, Nashville, TN 37202.

2. The Best Environmental Conservation Education, Local Conservation Districts.

3. Chemical Energy: Science Activities in Energy. The American Museum of Atomic Energy, Oak Ridge Associated Universities, P. O. Box 117, Oak Ridge, TN 37830.

4. Environmental Education Packet, The World Around You. The Garden Club of America, 598 Madison Avenue, New York, NY 10022.

5. Nutrition Know How. Procter and Gamble Educational Services, P. O. Box 14009, Cincinnati, OH 45214.

(Over)

6. "Pollution vs. Nature," Scholastic News Citizen. March 6, 1981, Vol, 49, No. 18.

7. Score More with Breakfast. Public Affairs Department, Kellogg Company, Battle Creek, MI 49016.

8. What is Energy, Book I. The Department of Energy, Office of Consumer Affairs, The Education Programs Division, Washington, DC 20585.

Activity 77
THE EFFECTS OF ACID RAIN ON PLANTS SCIENCE

Objective: To help students understand how the burning of coal has helped create an increase in acidic rainfall.

Procedure:

1. Coal is being used to produce electrical power and is used in many industrial processes. The burning of coal produces SO_2 (Sulfur Dioxide) which reacts with water and sunlight to form H_2SO_4 (Sulfuric Acid) should be illustrated to the students.

2. Solutions of various pH solutions should be made (pH 3-7) and sprayed on plants (for 2 to 3 weeks) to show the effects of acid rain. Other factors can be examined through this experiment as to the effects upon the biota.

Resources:

1. Acid Rain, United States Environmental Protection Agency. 1980. Office of Research and Development, Washington DC (EPA-600/9-79-036).

2. The Garden Club of America, 598 Madison Avenue, New York, NY 10022.

3. Soil Conservation Society of America, 7515 NE Ankeny Road, Aekny, IA 50021.

Activity 78
A BIOASSAY USING STRIP MINE LEACHATES ON MACROINVERTEBRATES SCIENCE

Objective: To show the effects of improper strip mining on the aquatic macroinvertebrate community.

Procedure:

1. With the increase demand for energy and the return to coal to solve many of these needs, strip mining has led to the contamination of many streams and rivers. Students should be shown slides or pictures of strip mine areas and given an understanding of how acid and heavy metals are released from strip mine areas into the aquatic environment.

2. The bioassay should be set up by obtaining strip mine leachate or soaking crushed coal in water for a week and decanting the leachate. A percentage leachate should be made 100, 75, 50, 25, and 5%, and then placing 10 organisms into each jar. A graph of the experiment then can be plotted for percent leachate against mortality.

Resources:

1. Coal Mining Institute of America, 416 Ash Street, California, PA 15419.

2. Coal Mining and Water Quality. Tennessee Valley Authority, 400 Commerce Avenue, Knoxville, TN 37902.

3. National Coal Association, 1130 Seventeenth Street, NW, Washington, DC 20036.

Activity 79
THE EFFECTS OF ACID (pH) UPON AQUATIC PLANT LIFE SCIENCE

Objective: To show the student the environmental impact of strip mining upon the aquatic plant community.

Procedure:

1. Elementary students will be exposed to the facts of the increasing use of coal for coal-fired power plants as energy demand increases.

2. Show slides or photographs of strip-mined areas to illustrate the hazards of improper land management.

3. Acidic solutions ranging from pH 7 - pH 3 should be used. Place several branches of freshwater aquatic plant Elodea into each glass jar. Plants should be examined under the microscope at various time intervals to note the effect of the various acid solutions upon the aquatic plant.

Caution should be exercised in handling the various acidic solutions.

Resources:

1. Coal Mining and Water Quality. Tennessee Valley Authority, 400 Commerce Avenue, Knoxville, TN 37902.

2. National Coal Association, 1130 Seventeenth Street, NW, Washington, DC 20036

3. United States Environmental Protection Agency, Office of Research and Development, Washington, DC.

Activity 80
WASTE HEAT UPON AQUATIC MACROINVERTEBRATES SCIENCE

Objective: To show the student that increased demands for power generation will have an environmental impact through the discharge of waste heat.

Procedure:

1. A mini-course in which the elementary students will learn how coal-fired and nuclear power plants operate and the environmental impact that they place on the aquatic macroinvertebrate communities. Slides and transparencies would be used to assist in illustrating the problem.

2. The activity involves taking macroinvertebrates that have been acclimated to room temperature and placing ten of these organisms in preheated water at intervals of 5°F to a maximum of 30°F above room temperature. A graph then can be constructed showing mortality versus time. The activity will show the effects of waste heat discharges upon the macroinvertebrate community.

Resources:

1. Coutant, C. C.,"Biological Aspects of Thermal Pollution II, Scientific Basis for Water Temperature Standards at Power Plants," CRC Critical Reviews in Environmental Control, 3(1): 1-24, 1972.

2. Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460.

Activity 81
ECOLOGICAL RELATIONSHIPS

SCIENCE

Objective: The students will become aware of changes in the natural world, adaptation of plants to an area disturbed by man, and will be able to identify five plants.

Procedure:

1. In class preparation: Explain the theory of succession to students. Include blue-green algae, grass, small broadleaf weeds, lichens, sumac, red cedar, honey locust, tulip poplar, oak and hickory. Talk about possible reasons for an area to become clear of plant life.

2. Take the children outdoors. Show students many of the plants found at the site.

3. Have students in groups of two. Stake off an area 10'by 10' and try to find and identify all the different plants.

4. Have students list the plants found within their area in the possible order they would appear.

5. Have students make a map of their plot and mark areas where groups of plants are found.

6. Have students list possible environments that each plant would grow best in. Have students show how one environment created by one type plant might encourage other plants to grow, thus eliminating the original environment.

7. Back in the classroom, have students write a report on their ideas including types of plants, types of environment, succession and adaptation. The students will come to some conclusion as to whether the area is in climax or not.

8. Students will read reports to the groups and compare the findings of others.

Resources:

1. American Forestry Association, 1319 18th Street, NW, Washington, DC 20006.

2. Brockman, Frank C. and Herbert S. Zim. Trees of North America. Golden Press (Golden Nature Guide Series), 1968.

3. Garden Clubs of America, 598 Madison Avenue, New York, NY 10022.

4. Parsons, Francis T. How to Know the Ferns. Dover Press, 1961.

(Over)

5. Shuttleworth, Floyd S. and Herbert S. Zim. Nonflowering Plants. (Golden Nature Guide Series), 1967.

6. Zim, Herbert S. and Alexander C. Martin. Flowers: A Guide to Familiar American Wildflowers. (Golden Nature Guide Series), 1961.

Activity 82
AN ADEQUATE SUPPLY OF PURE WATER IS ESSENTIAL FOR LIFE SCIENCE

Objective: The student will be able to draw and explain, orally or written, the water cycle.

Procedure:

1. Show the film entitled "The Water Cycle."
2. Read Modern Earth Science, pp. 256-259.
3. Data Analysis:
   (a) graphs of water usage and projections
   (b) maps showing drainage by rivers, lakes, streams, etc.
   (c) drawings of water recycling in city treatment plant
   (d) reports on water conditions relating to pollution and possible solutions

Resources:

1. Modern Earth Science. Holt, Rinehart, Winston, 1969, pp. 256-259.
2. "The Water Cycle." 10 minute film, Encyclopedia Brittanica Films, Inc.

SOCIAL STUDIES

Activity 83
THE ENERGY CRISIS

SOCIAL STUDIES

Objective: To help students understand that a sudden change in the supply or demand for energy may cause a crisis that can affect many aspects of our society.

Procedure:

1. Have students examine a series of headlines from the coal strike of 1978 to see some of the effects of a sudden shortage of fuel. They should be able to make decisions about how to allocate fuel if a shortage cut off is needed. Compare with coal strike of 1981.

2. Students should be able to:

   (a) define shortage by giving examples.

   (b) infer from data the effects of a shortage of energy.

   (c) evaluate different decisions about allocating resources during a shortage.

   (d) define scarcity.

   (e) apply the concept of scarcity to the energy situation of supply and demand.

   (f) interpret graphs and cartoons pertaining to energy.

Resources:

1. The Energy Challenge. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

2. The Energy Crisis - What You Can Do About It. Standard Oil Company (of Indiana), Mail Code 3705, 200 E. Randolph Drive, Chicago, IL 60601.

3. The Energy Future Today, Grades 5-6, U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

4. The Idea That Worked, Soil Conservation Society of America, Ankeny, IA 50021.

5. Michael Recycle, Reynolds Aluminum Recycling Co., Richmond, VA 23261.

6. The Nashville Tennessean,"Energy 81: Profits, Prices on Rise," Sunday, January 11, 1981.

7. THINK - Anybody Out There Think the Energy Crisis is Over? The IBM Employee Magazine, October/November 1976 (Reprint).

Activity 84
ENERGY CONSERVATION

SOCIAL STUDIES

Objective: Students will be able to tell how energy is helpful to them in their homes and suggest ways energy can be used wisely.

Procedure:

1. The children need to realize that fossil fuels such as oil and natural gas are in very short supply. Conservation of energy resources is essential. But conservation will require a change in our attitudes and lifestyles. Conservation works only when everyone cooperates.

2. Have the children draw a diagram of their house. Label the rooms (kitchen, bedroom, bathroom, living room, etc.).

3. Have them take this drawing home and list in each room all the energy helpers in each room.

4. On the second day discuss each room in turn, and make a list of the energy helpers in each room.

5. Lead them to see the vast amounts of energy being used when we all use these energy helpers.

6. Have children fill out the Lifestyle Survey Form. Discuss attitudes and willingness to change lifestyles in order to conserve energy.

7. Sponsoring a poster contest will afford students an excellent opportunity to apply their knowledge about the energy situation and the need for conservation.

8. Use Energy Ant booklets to reinforce teaching on energy conservation. Comic books on energy conservation will also stress the need to conserve.

9. Encourage each child to ask his/her parents to help with the Energy Saver Checklist.

Resources:

1. Energy Activities with Energy Ant. U.S. Department of Energy, Office of Consumer Affairs, Washington, DC 20585.

2. Exxon, USA, P. O. Box 2180, Houston, TX 77001.

3. Tennessee Valley Authority, 400 Commerce Avenue, Knoxville, TN 37902.

4. U.S. Environmental Protection Agency, Washington DC 20460.

Activity 85
ENERGY AND THE FUTURE

SOCIAL STUDIES

Objective: To encourage an interest in energy and energy conservation, and develop ideas on methods of energy available for the future.

Procedure:

1. Gather materials - newspapers and scissors.
2. Pass newspapers out to students.
3. Have students look through these newspapers and clip out articles that deal with energy.
4. Have each student give a report (orally) on the article they cut out.
5. Make a bulletin board so all students will have the opportunity to read these articles.
6. Have students make a vocabulary list of the "energy" words they see most often in their article.
7. Collect these words and have a spelling bee. Words might include: electricity, coal, shale, thermostat, conserve, gas, oil, resource, solar.

Resources:

1. The Energy Challenge, U.S. Department of Energy, Washington, DC 20585.
2. Local newspaper office.

Activity 86
ENERGY CONSERVATION

SOCIAL STUDIES

Objective: To familiarize students with the meaning of energy and the relative importance of conservation.

Procedure:

1. Ask students to give a definition of energy (allow for discussion).
2. Explain that energy is the power to make things move. Explain the different forms that energy takes on - radiant (sun), mechanical (waterfall), electrical (electricity through transmission wires), chemical (heat energy in food causing it to change it's form).
3. Ask students if they can demonstrate a type of energy.
4. Take an energy field walk. Have students go outside and talk about different ways energy is converted. Talk about ways we could conserve energy now that we know the types of conversions that take place.
5. Have students make a chart that includes objects viewed, energy source, product.
6. Talk about past sources of energy and present sources of energy.
7. Discuss the "good old days" and ask children if they would like to return to these days and give reasons as to why they would or would not like to go back to these times. Ask students what they feel the future holds as far as energy is concerned.
8. Have students write a story on "The Day I Went Back in Time" and cite the differences in types of energy available then and now.
9. Ask students who they feel uses the most energy:

Industry	Transportation
Commerce	Residents

Allow for discussion and have students give reasons why they answered as they did. Then explain why industry is the number 1 user of energy, transportation is number 2, residents are number 3, and commerce is 4.

Resources:

1. Energy and Man's Environment, 0224 SW Hamilton, Suite 301, Portland OR 97201.
2. Tennessee Energy Authority, 709 Capitol Boulevard Building, Nashville, TN 37219.
3. Thompson, Ray. The Energy Link. Ginn and Company, 1978, Lexington, MA.

Activity 87
HOW COAL WAS FORMED

SOCIAL STUDIES

Objective: Students will describe how coal was formed and how it is mined.

Procedure:

1. In introducing this activity, stress that although our coal reserves are plentiful, with enough to last an estimated 350 years at our present rate of consumption, they are also finite. Be sure that students realize it takes millions of years for coal to form in the earth and that man cannot duplicate the process.

2. The second part of the activity describes some advantages and disadvantages of both surface and undergound mining, the two major methods of coal recovery. The mining method used depends on the location of the seam of coal, its thickness, and the amount and type of overburden. Surface (strip) mining is a fast and efficient way to mine coal near the earth's surface. This is done either by removing earth and rock above the coal over large flat areas of land surface or by making a cut around the edge of a mountainside (contour mining) to expose and remove outcrops of coal. The problems presented by surface mining are primarily those of restoring the land area disrupted by the mining operations.

   Underground mining has been practiced for centuries and has always been considered a very hazardous occupation. While modern machinery and technology have reduced or eliminated many of the threats to miners' lives and health, the increases in safety precautions and modern equipment have contributed to the rising cost of coal to the consumer.

   Because of our current need for coal, we can be sure that both surface and underground mining will increase. Though coal from surface mines appears to be cheaper, students should know that damage to the environment also constitutes a cost. Perhaps they will think of some compromise such as surface mining in areas that can be restored and paying for the restoration by increased energy costs, a remedy that is occurring even now.

Resources:

1. The Energy Challenge. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

Activity 88
THE GOOD OLD DAYS?

SOCIAL STUDIES

Objective: Students will have an opportunity to discover how petroleum and natural gas have changed American lifestyles during the past fifty years, and to consider whether they would want to return to the "good old days."

Procedure:

1. This activity gives students a chance to explore the memories of older members of the community. They may wish to find out about the "good old days" by visiting someone in small groups. If some students do not have a grandparent or older adult living close by, they may want to combine their energy-unit interview with a social visit to a local nursing home or senior citizen's center.

2. Encourage class members to think up additional questions of their own.

3. When the interviews are completed, discuss the answers together and tally results. Ask students if they would like to have lived fifty years ago.

Resources:

1. The Energy Challenge. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

Activity 89
PAST AND PRESENT ENERGY SOURCES

SOCIAL STUDIES

Objective: The Student will be able to compare early and modern sources of energy.

Procedure:

1. List the energy resources that early man used for the following activities:

   (a) Heat his shelter: sun, wood, peat, or charcoal

   (b) Make tools: wood, peat, charcoal

   (c) Have light at night: wood

   (d) Find food: muscle power

2. List the energy resources that you, your family and community use for the following activities:

   (a) Heat your home: electricity, natural gas, oil, coal, wood

   (b) Run machines: electricity, oil, coal, natural gas

   (c) Have light at night: electricity

   (d) Find food: students should understand that food is grown, stored and packaged for them. Electricity is used for refrigeration. The machines for farming are usually run by the energy provided by petroleum or electricity.

3. Discuss using our modern sources of energy, what can we do today that early man could not do?

Resources:

1. Energy and Your Future Environment, The Chevron Research Company, 1973, Distributed by Visual Materials, Inc., Redwood City, CA.

2. Exxon Corporation, 1251 Avenue of the Americas, New York, NY 10020.

3. Gulf Oil Corporation, Gulf Building, Pittsburg, PA 15230.

4. Texaco, Inc., 135 East 42nd Street, New York, NY 10017.

Activity 90
ENERGY, PAST, PRESENT AND FUTURE SOCIAL STUDIES

Objective: The student and teacher will identify key topics and concepts in the study of energy resources as a basis for future study.

Procedure:

The students will study a group of worksheets, along with filmstrips and cassettes, transparencies and games, which are packaged together in a kit. The student will go through the following steps:

1. The students will be given a pre-test to see how much they already know about energy.

2. The students will study a list of terms dealing with energy.

3. The students will be able to define the terms "energy, fuel, and work," and describe their relationships. They will also develop some understanding of their own uses of energy.

4. The students will see the filmstrip and cassette, "Energy and Your Future," in conjunction with transparencies of past, present, and future energy resources.

5. The students will participate in the wall-chart game, "The Energy Game," where they will learn that there are limited amounts of energy resources and that the conservation of energy depends upon individual and corporate decision making.

After these activities, the students will be able to give consideration to the following:

1. Compare man's needs and uses for energy in the past, present, and future.

2. Understand some of his own uses of energy and how he makes it work for him.

3. Be able to discuss the relationship of population growth, a higher standard of living, and the need for more energy.

Resources:

1. American Petroleum Institute, 2101 L Street., NW, Washington, DC 2003[illegible]

2. The Chevron Research Company, Visual Materials, Inc., Redwood City, [illegible]

3. Elementary School Science Series. McGraw-Hill Book Company, Webster Division, New York, NY.

(Over)

4. IBM Corporation, IBM Employee Magazine, October/November 1976.

5. Tennessee Energy Authority, 709 Capitol Hill Building, Nashville, TN 37219.

6. Tennessee Valley Authority, Division of Energy Conservation, 400 Commerce Avenue, Knoxville, TN 37902.

7. The American Museum of Atomic Energy, Oak Ridge Associated Universities, P. O. Box 117, Oak Ridge, TN 37830.

Activity 91
ENERGY AND YOUR FUTURE ENVIRONMENT

SOCIAL STUDIES

Objective: To help the students understand how man has grown materially and technologically, but has not controlled many of the negative by-products of that growth.

Procedure:

1. Have students see the filmstrip and cassette, "Your Future Environment," along with transparencies on population growth.
2. The students will then work with worksheets and transparencies on population and how its rapid increase has created environmental problems.
3. Have students work with and discuss worksheets on air, land and water pollution and what is being done to solve the problems.
4. The students can participate in the wall-chart game "Newtown." This game allows students to make individual decisions concerning their life-styles and consequently their environment.
5. The students will be given a post-test to see how much they have learned about energy and the environment.
6. After completion of this project, along with that on "Energy, Past, Present and Future," the students will be given a certificate of completion.

Following this experience, the student will:

1. be able to recognize problems in his own environment and consider solutions to the problems.
2. understand that demands for higher standards of living without concern for the environment can be a cause of pollution.
3. be able to identify some technological advances and describe their possible effects on our environment.

Resources:

1. American Lung Association, 1740 Broadway, New York, NY 10019.
2. The American Museum of Atomic Energy, Oak Ridge Associated Universities, P. O. Box 117, Oak Ridge, TN 37830.
3. The Chevron Research Company, Visual Materials, Inc., Redwood Ctiy, CA

(Over)

4. Elementary School Science Series, McGraw-Hill Book Company, Webster Division, New York, NY.

5. Exxon, U.S.A., Public Affairs Department, P. O. Box 2180, Houston, TX 77001.

6. Reynolds Aluminum Recycling Company, Richmond, VA 23261.

7. Tennessee Energy Authority, 709 Capitol Hill Building, Nashville, TN 37219.

8. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

Activity 92
HOW COAL IS USED

SOCIAL STUDIES

Objective: Students will trace the route of energy from the coal mine to the electric light, and analyze current problems and opportunities we face in using coal.

Procedure:

1. Point out that in 1978 almost 77 percent of all coal mined in the U.S. was used to generate electricity. Then ask students to fold their papers in half lengthwise so that only the symbols and boxes on the left are visible. Explain that the symbols, which represent the steps involved in getting energy from the coal mine to their light bulbs, are scrambled.

2. Ask them to draw the pictures in the correct order in the spaces. When they unfold the paper, if the symbols have been drawn correctly, each will be opposite a written description of the process. Be sure that the class reads, preferably together, the information that accompanies each step.

3. On the back of the activity sheet or on another piece of paper, students can name some of the uses of electricity in their own surroundings. They might consider which of those uses they feel they could live without. Children are often intrigued by or receptive to modifications of life-styles. Although we probably will never go back to a simpler life without electricity, we will certainly face a period of conservation of resources and re-evaluation of priorities. Discuss various alternatives with your class.

4. Long-distance transmission of electrical energy is an inefficient process but if improved, it could give us additional energy resources. Much energy is lost because of heat and friction caused by resistance of the metal wires through which the electricity passes.

5. Some students might want to research and report to the class just how efficient energy use is in the various sectors such as industry and transportation.

6. The final activity asks students to describe some facts about our current coal situation either as problems or opportunities. Of particular interest is the third fact: 80 percent of the coal presently being mined comes from the East, but the western reserves contain approximately half of the recoverable coal in the United States. While substantial western reserves exist, mining of these resources presents problems also. Most western coal requires surface mining, and reclamation of western land will be more difficult because of the low rainfall and sparse vegetation in that part of the country. In addition, because major industrial centers are in the East, transporting the coal over long distances will be expensive.

(Over)

7. Most of the problems can be solved, but the solutions that are devised will probably be expensive. Students should finish the study of coal with a clear understanding that there are choices to be made: between using less energy or paying increased energy costs; between having as much energy as possible or protecting the environment; and between sacrificing beautiful land and natural ecological systems or paying the cost (in higher energy prices) of having them restored. A balance must be negotiated between energy requirements and preservation of the environment.

Resources:

1. The Energy Challenge. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

Activity 93
PETROLEUM: FROM NATURE TO YOU SOCIAL STUDIES

Objective: To help students develop an understanding of the formation of petroleum, its commercial development, and its importance today.

Procedure:

1. The world of today's student is oil oriented. In order to gain a fuller understanding of the obtaining of petroleum conduct an "information hunt." Using library reference materials make charts, graphs, and posters to illustrate the Story of Petroleum from Nature to You.

2. Specific information for use in "information hunt."

   (a) Prehistoric conditions under which formation began.

   (b) How early petroleum sources were obtained and used?

   (c) Ways we search for and discover petroleum.

   (d) Leading world fields.

   (e) Leading world producers.

   (f) Leading world consumers.

   (g) Graph use of petroleum versus availability (how long will known sources last?)

Resources:

1. Petrochemical Energy Group, 1701 Pennsylvania Avenue, NW, Suite 335, Washington, DC 20006.

2. Petroleum Industry Research Foundation, 122 East 42nd Street, New York, NY 10017.

3. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

Activity 94
SYNTHETIC FUELS

SOCIAL STUDIES

Objective: To help the students understand that synthetic fuels may be the answer to future energy supplies.

Procedure:

1. The basis for this study is to let the student research countries (such as Brazil) that have attempted to switch to alternative fuels. The technology is available to make combustion engines that run on alchohol or mixtures such as gasohol and methanol, i.e., methanol may become important because it burns clean and nonpolluting. Today it is made from natural gas, but could be made from coal or biomass.

2. Other apsects to introduce is the converting of gas-run engines to alchohol. The conversion is not complicated and within the future could ease the burden of the U.S. energy crunch.

3. The use of synthetic fuels is being studied as an alternative to fossil fuels as an energy source. The problem of making synthetic fuels is the overriding factor present today. The use of synthetic fuels has existed in the racing circles, but has not caught on with the present society.

Resources:

1. American Geological Institute, 2201 M Street, NW, Washington, DC 20037.

2. Center for Energy Information, 340 East 51st Street, New York, NY 10022.

3. Energy Research Corporation, 6 East Valerio Street, Santa Barbara, CA 93101.

4. Energy Research and Development Administration (ERDA), 20 Massachusetts Avenue, NW, Washington, DC 20545.

5. "Synfuels, Fill'er Up!" Energy National Geographic-Special Issue, pp. 90-91, February 1981.

6. Synthetic Organic Chemical Manufacturers Association, 1075 Central Park Avenue, Scarsdale, NY 10583.

Activity 95
PROBLEMS AND SOLUTIONS TO ENERGY PROBLEMS SOCIAL STUDIES

Objective: The student will become more aware of the problems of alternate energy sources and some solutions to these problems.

Procedure:

1. List and discuss new energy sources.
2. Discuss problems (if any exist) with new energy sources. Also list them.
3. If any disagreement occurs, the disagreeing party should be ready to defend the disagreement. The shortcomings of new energy sources would enhance our future generation about the pros and cons of alternative energy sources. Some of these sources have a definite impact on man and his environment.

Resources:

1. The Energy Challenge. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.
2. National Energy Resources Organization, 821-15th Street, NW, Suite 636, Washington, DC 20005.
3. Resources for the Future, Inc., 1755 Massachusetts Avenue, NW, Washington, DC 20036.

Activity 96
CAN ANYTHING BE DONE? SOCIAL STUDIES

Objective: To help students develop an understanding of the concept of supply and demand in relation to energy.

Procedures:

1. Collect materials: Cartoon Sheet (1) "Our Energy Appetite," "Classroom," and "Bicycling;" world energy bank handouts.

2. Activity I - Inferring from Cartoons

   (a) Distribute Cartoon Sheet #1. If the students need help in interpreting cartoons, work with them through each of the questions of how this cartoon shows scarcity. If the students were the "World Energy Doctor," what would they prescribe for the patient? What is the problem with each "prescription?"

   (b) Distribute Cartoon Sheet #2. This Cartoon Sheet with three cartoons may be used in a number of ways.

      (1) The questions on the back of the sheet may be duplicated and distributed to students, or

      (2) distribution of the cartoons can be made without the questions. Have the class identify the cartoon that:

         (a) shows ways to use less energy.

         (b) may imply that we just live with scarcity.

         (c) shows ways to increase the supply of energy.

   (c) What is the problem with each of the "solutions" offered in the cartoons?

   (d) Ask the students if they can define the word "tradeoff."

   (e) Have students identify a tradeoff in each of the cartoons.

   (f) Which of the tradeoffs do they seem most comfortable with? Why?

3. Activity II - The World Energy Bank

   (a) Before distributing the World Energy Bank sheet, ask the students what they would have to do if they wanted to buy an item that they couldn't afford.

   (b) If we want to have more energy in the future, what must be done now?

(Over)

3. (c) Hand out the Energy Bank sheet. Review with the students what each of the symbols for sources of energy mean.

   (d) Why are withdrawals from the Bank increasing?

   (e) According to the picture, by how much will energy consumption have grown by the year 2000?

   (f) How can "deposits" be increased?

   (g) How can "withdrawals" be reduced?

   (h) What are the problems with using less now?

   (i) What are the problems with increasing energy supply?

Resources:

1. The Energy Future Today, Grades 7,8 and 9, Social Studies. U.S. Department of Energy, Office of Consumer Affairs, Washington, DC 20585, April 1980.

2. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

Activity 97
COAL FACTS: COSTS AND BENEFITS

SOCIAL STUDIES

Objective: To help students to understand that the supply of energy can be increased in the short run in the United States by developing and increasing the use of coal, but this will involve investment and tradeoffs.

Procedure:

1. Collect booklets for student use: "The Coal Facts," "Coal: The Costs and Benefits," "The President's Cabinet."

2. Introduce the students to the idea of cost and benefits. Remind the students of the shortage exercise "Can Anything Be Done?" Oil could not be delivered. Assume that the community decides to close down the schools.

3. What can we infer about the way energy is used in the cartoon that is different from today?

4. Describe what the "cartoon world" looks like, keeping in mind the fact that all energy must be used to its utmost efficiency.

5. Can they see some advantages to this possible energy situation? What disadvantages?

6. Speculate with the class about possible relations between the present and the future.

7. Energy Decisions

   (a) Copy the "Possible Future Energy Situations" on separate pieces of paper.

   (b) Divide the class into four large groups and give each group one possible future energy situation. This is passed from student to student, each one adding a one sentence consequence of the situation on the paper.

   (c) Encourage the students to build on what they already know about energy and on the original statement. These statements should be consequences the students think could be possible. For example, one answer for situation #1 could be "Everyone would starve to death."

8. The Coal Facts

   (a) Distribute copies of "The Coal Facts" and the analysis sheet, "Coal: The Costs and Benefits."

   (b) Be sure that the class understands each piece of data on the handout.

8. (c) Allow time for discussion of the data. Some terms may need to be explained to the students.

(d) In small groups, or individually, have the students complete the worksheets.

9. The President's Cabinet

(a) Assign roles to the students. More than one person can serve as the Secretaries or each secretary can have several aides.

(b) Have students prepare brief presentations to be made at Cabinet meetings. Students can find data for these presentations on "The Coal Facts" sheets.

(c) To conduct the cabinet meeting arrange the chairs in an oval. Although the President can keep order, the students should be told that the cabinet meetings are very orderly and serious.

(d) At the end of the discussion, the President must make the decision. The President does not have to do this on the basis of a vote.

(e) After the meeting, the class can discuss if the President made a wise decision.

(f) What will the nation and Congress have to do to act on the President's decision?

Resources:

1. The Energy Future Today, Grades 7, 8 and 9 - Social Studies. U.S. Department of Energy, Office of Consumer Affairs, Washington, DC 20585.

2. National Coal Association, 1130 Seventeenth Street, NW, Washington, DC 20036.

Activity 98
WHY DON'T WE CONSERVE

SOCIAL STUDIES

Objective: To help students to see that decisions to conserve energy are made on the basis of knowledge, attitudes, cost, government sanctions, and technology.

Procedures:

1. Collect the following materials: Energy Quotes and Student's Conservation Survey.

2. In a large group discussion or small groups, have the students quickly identify the energy quotes. Have students sort or classify the quotes into those that may encourage the use of energy and those that may encourage the conservation. Why?

   (a) Have the students decide how these quotes influence behavior.

   (b) What other types of advertising currently on television, in magazines or on radios encourage or discourage the use of energy.

   (c) Is it easier to shift to using more or less energy? Why?

3. Have students complete the survey individually. Compile the answers to the questions. These can be listed on the board.

   (a) Encourage the students to express the reasons for their choice.

   (b) Students will probably disagree with each other. Ask for volunteers who are opposed to a particular viewpoint, have them explain their viewpoint to each other.

   (c) Tell the students that as a class they must reach a consensus about which of these proposals to recommend to the President or Governor. If a consensus is reached, try to identify why this particular solution was favored.

   (d) Which of these energy uses are necessities? Which are luxuries? What makes the difference?

   (e) In conserving energy what tradeoffs are they willing to accept? What aren't they willing to give up?

4. Conclude the lesson. Why should we conserve energy? Review with the class the supply and demand graph.

Resources:

1. Conservation Foundation, 1250 Connecticue Avenue, NW, Washington, DC 20036.

(Over)

2. Tennessee State Department of Conservation, 2611 West End Avenue, Nashville, TN 37203.

3. The Energy Future Today, Grades 7, 8 and 9 - Social Studies. U.S. Department of Energy, Office of Consumer Affairs, Washington, DC 20585, April 1980.

Activity 99
WHERE SAVINGS CAN BE MADE

SOCIAL STUDIES

Objective: To help students understand that changes in techology and lifestyles, while requiring some present tradeoffs and investments, may save energy for future needs.

Procedure:

1. For this activity you will need: Chart - "Where Energy Savings Could Be Made."

2. Brainstorm with the students all the ways they can think of that they might have saved energy today.

   (a) How could they save energy directly? How could they save energy indirectly?

   (b) Why might they choose (or not choose) to conserve in this way?

   (c) Which of these choices were under their control? Which choices were under the control of the parents or other authorities?

   (d) Which of these savings would be easy to make; which difficult? Why?

   (e) Would people of different economic levels have the same or different difficulties in making these choices?

3. Distribute copies of the Chart "Where Energy Savings Could Be Made."

   (a) Which of these savings could be made by changes in the way we live our lifestyle? Which would take major changes in technology? Which requires both?

   (b) If a barrel of oil costs $32, how much money would be saved by these changes?

   (c) What if the price of oil doubled? What savings could be made?

   (d) Using less energy will generally cost the consumer less money. What costs must the consumer take into account before deciding if it is economically profitable to invest in energy saving measures? Can some of these savings be made without financial cost? If these items don't cost money and they can save money, why don't people save energy in these ways?

Resources:

1. Conservation Foundation, 1250 Connecticut Avenue, NW, Washington DC 20036.

(Over)

2. Consumer Federation of America, Energy Policy Task Force, 1012 Fourteenth Street, NW, Suite 901, Washington, DC 20005.

3. The Energy Future Today, Grades 7, 8 and 9 - Social Studies. U.S. Department of Energy, Office of Consumer Affairs, Washington, DC 20585, April 1980.

Activity 100
NUCLEAR FISSION: COSTS AND BENEFITS SOCIAL STUDIES

Objective: To help students understand that the use of nuclear fission to provide an increase in the supply of energy in the near and mid-term is possible but involves a number of tradeoffs.

Procedures:

1. For this activity you will need: "Nuclear Fission: Costs and Benefits."
2. Have students examine the data on nuclear fission.
3. As a class, have the students identify some of the costs and benefits of increased nuclear production.
4. Have an informal debate on: "Nuclear power should be increased in the United States."
5. Conclude the lesson. What short term options are available to the United States for dealing with scarcity?

Resources:

1. Atomic Industrial Forum, Inc., 475 Park Avenue South, New York, NY 10016.
2. Clinch River Breeder Reactor Plant Project, P. O. Box U, Oak Ridge, TN 37830.
3. The Energy Future Today, Grades 7, 8 and 9 - Social Studies. U.S. Department of Energy, Office of Consumer Affairs, Washington, DC 20885.
4. Nuclear Power and the Environment. American Nuclear Society, 244 East Ogden Avenue, Hinsdale, IL 60521.

Activity 101
OIL? FROM SHALE?

SOCIAL STUDIES

Objective: To demonstrate to students that oil shale is being considered as a very realistic source of oil in the future, and to make students aware of the need to explore new ideas for energy sources.

Procedure:

1. Since Tennessee has large deposits of oil shale the students might develop panel groups to explore the effects of mining oil shale. What effects might this have on the economy of Tennessee? What threatening environmental impacts might it have?

2. Each panel will discuss and choose a topic of importance after the teacher has explored these areas in class discussion. Specific questions might include:

   (a) Where in Tennessee are these deposits located?

   (b) How shall these deposits be taken from the earth?

   (c) What effects will mining have on the surrounding environment?

   (d) What benefits can we see from this industry?

   (e) How much oil will these deposits produce?

   (f) What will become of the land when mining operations cease?

3. Encourage exploration of all aspects of oil from shale. We need energy and this may be a source. Look at pros and cons.

Resources:

1. Oil Shale. Channing L. Bete Co., Inc., 45 Federal Street, Greenfield, MA 01301.

2. Oil Shale, A Potential Source of Energy. U.S. Department of Interior, Geological Survey. USGS: INF-71-13 (R.3), Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

3. Supplementary Energy Sources. American Petroleum Institute, Publications and Distribution Section, 2101 L Street, NW, Washington, DC 20037.

Activity 102
ENERGY AND GEOGRAPHY

SOCIAL STUDIES

Objective: Students will be able to understand and describe the importance of a network concept in relation to energy problems.

Procedure:

1. Gather materials: map of community, yarn or string, tape or pins.

2. Have the students locate on the community map: a power plant, the school, city hall, home, local businesses. Using the yarn to represent the means by which energy is transported, have students get electricity from the power plant to each of the above places. The yarn supplies the energy to all these places.

3. Ask the following questions.

   (a) How does the energy get to each place?

   (b) Do the yarn lines show all of the wires needed to transport the energy? If not, tell what others may be needed. What may happen to the network if a line is broken?

4. On the map identify places where students in the class have travelled. How far was the longest trip? How many miles? What forms of energy were used in these travels? Where was the energy obtained which enabled this network to work? Where was the place that was travelled to most often?

Resources:

1. Energy Activities: A Station Approach. Tennessee Valley Authority, Environmental/Energy Education Program, Division of Land and Forest Resources, Norris, TN 37828.

2. Local City Map.

Activity 103
ENERGY AND GEOGRAPHY

SOCIAL STUDIES

Objective: Students will become aware of the cities in the United States that consume the most energy and be able to understand why these cities consume more.

Procedure:

1. Gather materials: map (United States), Social Studies Workbook and Textbook.
2. Divide the class into four groups. Give the groups the title of North, South, East, and West.
3. Have students cite major cities in each area in #2. Then have the students find out why they're so large (climate, population, industry, etc.)
4. Have students chart the different types of energy used in each city and see which type of energy is used more frequently. Discuss the areas that would benefit the most from solar energy.
5. Discuss TVA and the benefits it brings to Tennessee residents.
6. Have students brainstorm to think up ways these cities could save energy.
7. Have students discuss the usage of coal and its effects on the people in smaller, rural areas. Allow the students to debate the "pro's and cons" of coal as a major source of energy. Be sure to include some of the problems in mining coal and the relatively inexpensiveness in comparison with other sources of energy.
8. Pass out a ditto sheet that can be colored by the students in which the cities that consume more energy by coal be colored black, the ones who consume more energy by solar energy be colored in yellow, the ones who use more geothermal be colored in gray, and the ones using more chemical energy be colored in blue.
9. As a type of followup have students write a story on "The Day All Energy Stopped."

Resources:

1. Kaplan, Sandra Nina, Jo Ann Butom Kaplan, Sheila Kunishima Madsen, and Bette K. Taylor. Change for Children - Ideas and Activities for Individualizing Learning. Goodyear Publishing Company, Inc., Pacific Palisades, CA, 1973.
2. Local Library.

Activity 104
WHERE WE GET OUR ENERGY: HOW WE USE IT SOCIAL STUDIES

Objective: Students will learn the four sectors of energy users and how these groups consume the major primary energy resources, analyze their own energy consumption in relation to the four sectors of use and increase their awareness of their own stake in solving our energy problems.

Procedure:

1. When discussing energy consumption, energy experts generally divide our society into four sectors: transportation (which includes trucks, trains, planes, buses, motorbikes, ships, etc.); industrial (factories); commercial (stores, offices, schools, hospitals, theaters, churches, etc.); and residential (homes and apartments). Graph A shows the percentage of our nation's energy used by each sector. It shows, for example, that industry is the biggest user of energy, that transportation runs a close second, and that the rest of the energy pie is divided by the commercial and residential sectors.

2. It is important for students to see that all of us are involved directly or indirectly in each sector. The exercise that accompanies Graph A dramatizes for them that many of their daily actions contribute to the total amount of energy each of the four groups use.

3. In a later unit on energy conservation students will discuss further some ways that they, as individuals and members of society, can save energy. For now, it is sufficient that they be aware of the general areas in which they can have the opportunity to take direct action to save energy - at home, at school, and on the road.

4. Graph B shows the primary energy resources that the four groups on Graph A consume. The data reinforce a fact students have already learned: we have come to rely on three primary sources of energy to meet our needs - oil, natural gas and coal. It also presents them with a new fact: our two other important primary energy sources - hydroelectric and nuclear - meet a comparatively small percentage of our energy needs. One question below the chart asks students to consider why hydroelectric power will not be a major source for the future. Some students will probably be able to say that hydroelectric power offers little hope because there simply is not enough falling water to supply us with large amounts of power.

5. You might ask students why they think nuclear energy represents such a small percentage (3.9 percent). Some students will probably know that public concern about safety and high construction costs have slowed the production of nuclear energy.

Resources:

1. The Energy Challenge. U.S. Department of Energy, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

Activity 105
ENERGY EFFICIENT CITY

SOCIAL STUDIES

Objective: To make the students more aware of the necessity of conservation methods through looking at the energy consumption of a large city and to allow them to plan and suggest methods of conserving energy by planning a city.

Procedure:

1. Divide the class into groups to help design an energy-conserving city. Have the following committees:

Transportation	Energy Production
Housing	Recreation Facilities
Communications	Schools

   Each committee should keep in mind the necessity that planning must be centered on the conservation of energy.

2. Four questions they might ask are:

   (a) How do changes in population affect what I choose?

   (b) How will my choice change the environmental status of the area?

   (c) How will it affect the health of all concerned?

   (d) Are the necessary energy sources available and where do they come from?

3. Allow the class to do a layout by coordinating all committees.

Resources:

1. Mayor's Energy Conservation Committee, c/o Environmental Planning and Management Project, Metropolitan Government of Nashville and Davidson County, Stahlman Building, Suite 615, Nashville, TN 37201.

2. Tennessee Department of Transportation, Bureau of Area Mass Transit, 817 Highway Building, Nashville, TN 37219.

3. U.S. Department of Health and Human Services, Office of Consumer Affairs, Washington, DC 20201.

Activity 106
USES OF ENERGY SOURCES

SOCIAL STUDIES

Objective: The student will be able to define the terms energy, fuel and work, and describe their relationships while also developing an understanding of some personal uses of energy resources.

Procedure:

1. Use your dictionary to find the meaning of these words:

   (a) Energy: The power to do work

   (b) Fuel: Anything that is burned to give heat or power

   (c) Work: The use of energy or skill in doing or making something

2. Name the kind of energy or fuel you and your family use for each of the following activities:

Activities	Energy or Fuel
(a) Ride in the car	gasoline
(b) Watch television	electricity
(c) Cook out of doors or at a picnic	wood or charcoal
(d) Run and play using your muscles	food
(e) Grow flowers	soil and sun
(f) Keep food in the refrigerator	electricity or gas
(g) Cook food in the kitchen	electricity or gas

3. Can you find out where the electricity that you use at home comes from and how much you use each month? (Suggestion: ask you parents.)

_____

_____

Resources:

1. Energy and Your Future Environment. The Chevron Research Company, 1973, Distributed by Visual Materials, Inc., Redwood City, CA.

2. Phillips Petroleum Company, 4A4 Phillips Building, Bartlesville, OK 74003.

3. Texaco, Inc., 135 East 42nd Street, New York, NY 10017.

Activity 107
LAND POLLUTION

SOCIAL STUDIES

Objective: To learn about the local community's efforts to control land pollution.

Procedure:

1. Find out how solid waste materials are disposed of in your community. Do you think it is making your community better or is causing pollution?

   Students answer will vary by region.

2. List materials currently being recycled:

   Student answers may include: aluminum, wood, plastics, paper, oil, tin cans, glass containers, water, iron and steel

3. For a related project, visit your local garbage disposal facility. Become aware of:

   (a) depth of soil cover,

   (b) presence of rodents or insects,

   (c) proximity of lakes, rivers and reservoirs.

4. Discuss plans for future land use in your community.

5. Discuss what can be done to help in recycling newspapers and metal containers such as aluminum cans.

Resources:

1. Aluminum Recycling Association, 200 L Street, NW, Suite 502, Washington, DC 20036.

2. Energy and Your Future Environment. The Chevron Research Company, 1973, distributed by Visual Materials, Inc., Redwood City, CA.

3. National Association of Recycling Industries, 330 Madison Avenue, New York, NY 10017.

4. National Center for Resource Recovery, 1211 Connecticut Avenue, NW, Washington, DC 20036.

Activity 108
ENVIRONMENTAL IMPROVEMENT SOCIAL STUDIES

Objective: To learn about local efforts in the community to improve the environment.

Procedure:

1. What governmental agency is responsible for air pollution control in your community?

   Student answers will vary by region.

2. Describe the main systems of transportation in your community.

   Student answers will vary by region. Answers may include mass transit, trucking, or bus system.

3. What are industry and government doing in your community to control air pollution?

   Student answers will vary by region. Answers may include lists of municipal codes and state regulations.

4. List groups, clubs, or other organizations in your community that are working to improve the environment. Describe their activities.

   Answers may include special interest groups as well as government agencies.

Resources:

1. Center for Environmental Education, 1621 Connecticut Avenue, NW, Washington, DC 20009.
2. Citizen's Advisory Committee on Environmental Quality, 1700 Pennsylvania Avenue, NW, Washington, DC 20006.

Activity 109
WATER POLLUTION

SOCIAL STUDIES

Objective: To be able to identify the nature and effects of water pollution in the local community and what is being done to solve problems.

Procedure:

1. Explain where the water you use comes from.

   Student answers will vary by region. The class may find a visit to a dam, reservoir, or water treatment plant interesting and helpful.

2. What chemicals, if any, are added to make the water usable?

   Student answers will vary. Answers may include chlorine and flouride.

3. Will there be enough water for your community, if your population should double in the next 30 years?

   Student answers will vary.

4. Discuss how a water shortage, or water rationing, could affect:

   (a) agricultural production (farming).

   (b) industry.

   (c) leisure activities.

   (d) your home.

4. Related project: Fill a glass of water from your tap. Look at it. It should be colorless. Smell it. It should be odorless. Taste it. It should have no taste. Discuss what you have found.

5. Find out about the governmental agency, or agencies, in your area responsible for clean water.

Resources:

1. Energy and Your Future Environment. The Chevron Research Company, 1973, Distributed by Visual Materials, Inc., Redwood City, CA.

2. The Fertilizer Institute, 1015 Eighteenth St., NW, Washington, DC 20036.

3. U.S. Department of Agriculture, Washington, DC 20250.

4. U.S. Environmental Protection Agency 401 M St., SW, Washington, DC 20460.

ENERGY FAIR

Activity 110
AN ENERGY FAIR

SCIENCE

Objective: To give students the opportunity to provide a high impact activity on energy for the school and community.

Procedure:

1. Have students prepare and exhibit projects and posters concerning basic energy concepts and methods of conservation.
2. Show students film strips illustrating how to prepare and exhibit a science fair project. Show pictures of previous projects.
3. Use books from school library and free materials obtained from various sources for students to gain ideas.
4. To encourage participation, offer prizes, ribbons, and participation awards.
5. Select a panel of judges from other areas from school faculty, such as industrial arts, math, art, etc.
6. Have projects due one day before fair is to be held to enable judges to award ribbons and prizes.
7. On the day of the fair, hold "open house" for the entire school and the parents.
8. The area in which the fair is to be held will depend on school facilities. Some possibilities are science lab, auditorium, gymnasium, etc.
9. Use posters, radio, newspapers, etc. to publicize your fair.

Resources:

1. Thomas A. Edison Foundation, 143 Cambridge Office Plaza, 18280 West Ten Mile Road, Southfield, MI 48075. The following are 50¢ each or 3/$1.00.

   Alternative Energy Sources: Experiments You Can Do (1978)
   Energy Conservation: Experiments You Can Do (1978)
   Environmental Experiments (1973)
   Nuclear Experiments You Can Do (1979)
   Selected Experiments and Projects (1976)
   Useful Science Projects (1979)

2. The Energy Challenge. Federal Energy Administration, Washington, DC 20461.
3. Energy Research and Development Administration, 20 Massachusetts Avenue, NW, Washington, DC 20545.

(Over)

4. Experiments: Properties of Gas and Heat Energy. American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209.

5. Filmstrips: Preparing Your Science Fair Project; Exhibiting Your Science Fair Project, Encyclopedia Britannica.

6. The Power of Coal. National Coal Association, 1130 Seventeenth Street, NW, Washington, DC 20036.

7. Science Activities in Energy. The American Museum of Science and Energy, Oak Ridge Associated Universities, P. O. Box 117, Oak Ridge, TN 37830.

8. Tennessee Energy Authority, 709 Capitol Boulevard Building, Nashville, TN 37219.

9. Tennessee Environmental Council, P. O. Box 1422, Nashville, TN 37202.

10. Tennessee Valley Authority, 400 Commerce Avenue, Knoxville, TN 37902.

ENERGY/ ENVIRONMENTAL OPINION SCALE

Activity 111
ATTITUDES TOWARD ENERGY/ENVIRONMENTAL PROBLEMS

ENERGY/ENVIRONMENTAL
OPINION SCALE

Objective: To assess the opinions of students relative to energy/environmental problems.

Procedure:

1. The opinions that children hold relative to the study of energy and environmental education can be of value in designing activities and a course of study. The goal of any program in energy/environmental education is to make children aware of the problems and possible solutions. Therefore, it is suggested that the "Environmental Opinion Scale" be administered as a pre- and post-attitudinal measure.

2. Item scores can be computed and the Chi-square technique used to determine differences in opinions as a result of having been exposed to energy/environmental activities (see following page for copy of the instrument).

Resources:

1. Ayers, Jerry B. "Rural Children's Attitudes Toward the Energy Crisis," School Science and Mathematics. 76(3): 238-40, March 1976.

2. An elementary statistics or tests and measurements will provide sufficient information to compute the needed statistics for the instrument.

ENVIRONMENTAL OPINION SCALE

_____ Boy _____ Girl _____ Grade

Circle the number on the line below each statement, that shows how much you agree or disagree with the statement. The Opinion Scale WILL NOT AFFECT YOUR GRADES.

1. Man is responsible for spoiling his environment.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

2. Electrical plants which burn coal or oil are less dangerous than nuclear plants.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

3. We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

4. The use of electric cars will not affect the environment.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

5. We must produce electricity at any cost.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

6. All types of electrical generation cause pollution.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

7. Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

8. We must stop all forms of pollution.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

9. Nuclear power plants are dangerous to life and property.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

10. Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

11. Nuclear power plants are safe.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

12. Nuclear reactors must be developed to extend our fuel supply.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

13. Power plants must be located near major population centers.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

14. We must stop the generation of electrical energy to save our environment.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

15. Oil and natural gas are too valuable as raw materials to be burned as fuels.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

16. We must make the best possible use of all resources.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

17. Nuclear power must be stopped.

1	2	3	4	5
Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree

SECTION II

ANNOTATED BIBLIOGRAPHY

This annotated bibliography is divided into four sections: A. Energy: General Curriculum Guides, Teacher Information, and Materials and Resources, B. Energy Units and Activities, C. Environmental Education Curriculum Guides, and D. Index of Materials According to Grade Level and Subject Area. The source of the materials presented is the Educational Resources Information Center (ERIC Documents).

The materials available to educators in the ERIC System in Energy and Environmental Education is tremendous. This bibliography and index is not inclusive of all available sources, but is a beginning for one interested in developing an energy/environmental program in their subject area.

The identifier used in sections A. and B. was Energy Education, with descriptors such as Curriculum Guides, Teaching Guides, Elementary Education, and Secondary Education. Also included are several sources that are useful as teacher information for specific topics in the study of energy. Descriptors used in section C. are strictly Environmental Education, Curriculum Guides, and Teaching Guides.

Entries are numbered consecutively and indexed in section D. according to the following grade levels; K-3, 4-6, and 7 and above. Subject areas included in the index include; Art, Health, Industrial Arts, Language Arts, Mathematics, Music, Physical Education, Science, Social Studies, and Special Education. Other topics indexed are General Curriculum and Teacher Information and Materials.

A. ENERGY: GENERAL CURRICULUM GUIDES, TEACHER INFORMATION, MATERIALS AND RESOURCES

1. Banathy, Bela H., and Stephen R. Mills. The Environmental Education Teacher Training Models Project, April 15, 1977 to November 15, 1978. Final Report. U.S. Educational Resources Information Center, ERIC Document ED 178 324, November, 1978.
   Four environmental education models described. One targeted for elementary and intermediate teachers seeking to infuse environmental and energy education into natural science courses.

2. Campbell, Bruce. Energy Education Handbook. U.S. Educational Resources Information Center, ERIC Document ED 144 261, October, 1977.
   A curriculum model for teachers in grades K-12 to give them an orientation to energy education and to encourage research and teaching beyond initial content.

3. Carey, Helen H. ed. Award Winning Energy Education Activities for Elementary and High School Teachers. U.S. Educational Resources Information Center, ERIC Document ED 159 022, 1977.
   Descriptions of ten winning entries of the National Science Teachers Association Teacher Participation Contest conducted in 1976.

4. _____. Energy Education Workshop Handbook: A Guide to Materials by the Project for an Energy-Enriched Curriculum. U.S. Educational Resources Information Center, ERIC Document ED 180 794, 1978.
   A handbook designed to help teachers, supervisors, club leaders, and service directors lead workshops in energy education.

5. Coon, Herbert L., and John Disinger. Energy Education Programs. Elementary School Programs and Resources. U.S. Educational Resources Information Center, ERIC Document ED 183 386, April, 1979.
   Examples of energy education and their resources are described.

6. Coon, Herbert L., and Michele Y. Alexander. Energy Investigations for the Classroom. U.S. Educational Resources Information Center, ERIC Document ED 130 833, 1976.
   Sourcebook of energy teaching activities relating to resources, production, distribution and use for grades K-12. Activities are interdisciplinary in nature.

7. Cornbleth, Catherine, and John C. McGrail. Urban Environmental Education Project: Curriculum Series Overview and Teaching Guide. U.S. Educational Resources Information Center, ERIC Document ED 184 858, November, 1979.
   Teachers guide for urban environmental and energy education model intended for grades 6-9, drawing primarily on natural and social sciences.

8. Dukert, Joseph M. Nuclear Power and the Environment. U.S. Educational Resources Information Center, ERIC Document ED 130 847, 1976.
   The major environmental effects of nuclear produced electricity are discussed.

9. Eaton, William W. Energy Storage. U.S. Educational Resources Information Center, ERIC Document ED 130 844, 1975.

The technological considerations of energy storage, particularly electrical energy are described.

10. _____. Energy Technology. U.S. Educational Resources Information Center, ERIC Document ED 130 845, 1975.
Technological problems faced in energy production are reviewed.

11. _____. Geothermal Energy. U.S. Educational Resources Information Center. ERIC Document ED 130 846, 1975.
The nature and origin of geothermal energy are discussed, along with its history and development as an energy source.

12. _____. Solar Energy. U.S. Educational Resources Information Center, ERIC Document, ED 130 848, 1976.
The utilization of solar energy for the production of electricity is discussed.

13. Educator's Introduction to Energy Concepts: Overview Packets. U.S. Educational Resources Information Center, ERIC Document, ED 162 886, November, 1977.
Publication presents a broad overview of energy and related issues for teachers and others who want to improve their understanding.

14. Energy: An Annotated Bibliography of Selected Energy Education Materials. U.S. Educational Resources Infomation Center, ERIC Document ED 162 912, 1977.
An annotated bibliography of energy related materials including: bibliographies, pamphlets, books, periodicals and articles, teaching guides, and audiovisual materials.

15. Energy Conservation, Understanding and Activities for Young People. U.S. Educational Resources Information Center, ERIC Document ED 125 885, 1976.
Resource material for energy education in the classroom including a definition of energy, conservation of energy and uses of energy.

16. Energy Curriculum for the Middle Grades. Unit One: Energy and World Cultures With Adaptations for Science, Language Arts, and Practical Arts. U.S Educational Resources Infomation Center, ERIC Document ED 187 554, April, 1980.
A guide to help teachers integrate energy education into middle schools or junior high schools. Sections include an introduction, bibliography, and glossary addressing world wide energy issues.

17. Energy Curriculum for the Middle School Grades, An. Unit Two: Energy and American History With Adaptations for Science, Language Arts and Practical Arts. U.S. Educational Resources Information Center, ERIC Document ED 187 555, April, 1980.
Guide for the integration of energy education into a middle school curriculum. It contains a teacher's guide, glossary, and bibliography for various eras of American histroy.

18. Energy Education Materials Bibliography. U.S. Educational Resources Infomation Center, ERIC Document ED 162 900, June, 1978.
An annotated bibliography of selected energy education materials, that are indexed according to material type and grade level.

19. Energy Education Materials Bibliography Up-Date. U.S. Educational Resources Information Center, ERIC Document ED 184 856, October, 1979.
Updated version of previous bibliography prepared in ED 162 900. Materials indexed by grade level, background material, or activities for classroom.

20. Energy Education Materials Inventory Part One: Print Materials. U.S. Educational Resources Information Center, ERIC Document ED 133 192, September, 1976.
One of a six-part inventory of energy education materials. Included is a listing of print materials such as: teacher's guides, curriculum guides, ditto masters, textbooks, pamphlets, and posters. Infomation for each is given - title, author, availability, cost, grade level, related materials, and a material evaluation.

21. Energy Education Materials Inventory Part Two: Non-Print Materials, Part One. U.S. Educational Resources Information Center, ERIC Document ED 133 193, September, 1976.
One of a six-part listing of energy education materials including; films, filmstrips, slides, transparencies, audio-tapes and records.

22. Energy Education Materials Inventory Part Three: Non-Print Materials, Part Two: 16 mm Films. U.S. Educational Resources Infomation Center ERIC Document 133 194, September, 1976.
This is a listing of 16 mm films dealing with energy education.

23. Energy Education Materials Inventory Part Four: Kits, Games and Miscellaneous Curricula. U.S. Educational Resources Information Center, ERIC Document ED 133 195, September, 1976.
One of a six-part listing of energy education materials including; kits, games, and other related materials.

24. Energy Education Materials Inventory Part Five: Reference Sources. U.S. Educational Resources Information Center, ERIC Document ED 133 196, September, 1976.
Included is a listing of bibliographies, computer sources of information, directories, educational programs, funded projects, periodicals, and journals. Part of a six-part energy education material inventory.

25. Energy Education Materials Inventory, Volume I: An Annotated Bibliography of Currently Available Materials K-12 Published Prior to May, 1976. U.S. Educational Resources Infomation Center, ERIC Document ED 160 439, May, 1978.
Systematic listing of energy education materials and reference sources suitable for use in elementary and secondary schools. Materials are divided into media, grade level, and subject.

26. Energy Education Materials Inventory, Volume II: An Annotated Bibliography of Currently Available Materials, K-12. U.S. Educational Resourses Information Center, ERIC Document ED 183 360, August, 1979.
Inventory consisting of three sections, core-containing titles, and descriptive information and categorized according to medium, grade level, and subject.

27. Energy Education Resource Guide. U.S. Educational Resource Information Center, ERIC Document ED 156 474, January, 1978.

Entries are available from ERIC or Dissemination Services Unit. A brief description along with title and author information is given.

28. Energy Management for School Administrators: Curriculum Infusion Facilities Audit. U.S. Educational Resources Information Center, ERIC Document ED 183 369, 1979.
State guidelines and framework for the infusion of energy education into the Texas public school curriculum. Designed to assist teachers, administrators, and school personnel.

29. Energy On Film. U.S. Educational Resources Information Center, ERIC Document ED 168 814, 1978.
A guide to films on energy conservation issues. For each film listed a description of its contents and length is given along with the source. Some filmstrips and audio-visual materials packages are listed.

30. Energy Primer, The. U.S. Educational Resources Information Center, ERIC Document ED 164 299, 1976.
Information source for teachers. Divided into separate energy-related sections with student participation discussion activities.

31. Energy Resources Inventory for Connecticut Educators. U.S. Educational Resources Information Center, ERIC Document ED 186 283, January, 1980.
A guide including topics such as; background materials, energy curricula, economics of energy, today's fuels, future fuels, and a listing of instructional material and resources.

32. Erickson, Kathy Baker, and Deborah Fick Sherman. Energy in the Classroom, Volume I, Activities Guide for K-3. U.S. Educational Resources Information Center, ERIC Document ED 141 065, August, 1975.
Teachers guide for teaching about energy, types of energy, sources of energy, and ways to conserve energy. Activities sheets and a bibliography of student references are included.

33. _____. Energy in the Classroom, VolumeII, Activities Guide for Grades 4-7. U.S. Educational Resources Information Center, ERIC Document ED 141 066, August, 1975.
Teacher's guide for teaching about energy types, sources, and ways to conserve. Activity sheets and a bibliography are included.

34. _____. Energy in the Classroom, Volume III, Activities Guide for Grades 8-12. U.S. Educational Resources Information Center, ERIC Document ED 141 067, August, 1975.
Teacher's guide for teaching about energy, types of energy, sources and ways to conserve. Activity sheets and a bibliography are included.

35. Gillespie, Judith A. Energy Curriculum for the Elementary Grades. Unit I Energy and You, Unit II Energy and Your Community, Unit III Energy in Action. U.S.Educational Resources Information Center. ERIC Document ED 173 086, May, 1979.
Collection of materials for lessons in adapting energy into different grade levels of language arts and mathematics instruction.

36. Kooi, Warren James. An Analysis and Evaluation of the NSTA Energy Education Materials Produced by Project PEEC. U.S. Educational Resources Information Center, ERIC Document ED 178 320, 1979.

A thesis that analyzes the materials produced by the Project for an Energy Enriched Curriculum (PEEC).

37. Gillespie, Judith A. Lessons from an Energy Curriculum for the Elementary Grades. U.S. Educational Resources Information Center, ERIC Document ED 168 877, October, 1978.
Curriculum guide composed of three units: K-1, 2-3, and 4-6. Objectives are to develop an awareness of an information about energy conservation as well as improve inquiry skills and participation habits.

38. _____. A Plan for an Energy Curriculum for the Elementary Grades. U.S. Educational Resources Information Center, ERIC Document ED 167 355, June, 1978.
An outline to develop, evaluate, and disseminate a set of curriculum materials in K-6 grades.

39. Haveman, Jacqueline E. and Kathryn O'Connell. The Energy Conservation Curriculum Model. U.S. Educational Resources Information Center, ERIC Document ED 178 323, April, 1979.
Model for the systematic, conceptual framework for understanding energy. Specified for postsecondary vocational information but is useful for teacher information..

40. Herstik, Lawrence, and Judith Burnett. Teaching About the Energy Crisis in Grades K-12. U.S. Educational Resources Information Center, ERIC Document ED 162 892, 1977.
A Curriculum guide for multidisciplinary energy education. Materials presented are activity ideas for various energy education themes for each grade level and for science, home economics, and health and physical education classes.

41. Jones, John, and Edward Dalton. The Energy and Environment Glossary. U.S. Educational Resources Information Center, ERIC Document ED 159 042, 1977.
A glossary of words that commonly appear in energy education and environmental education materials. Over 750 words listed for use in upper elementary and junior high students with non-technical definitions.

42. Jones, John ed. Energy and Man's Environment: Activity Guide. An Interdisciplinary Teacher's Guide to Energy and Environmental Activities, U.S. Educational Resources Information Center, ERIC Document ED 166 009, 1976.
Teacher's guide to a six-part series on energy/environmental activities.

43. _____. Energy and Man's Environment Activity Guide: An Interdisciplinary Teacher's Guide to Energy and Environmental Activities, Section One - Sources of Energy. U.S. Educational Resources Information Center, ERIC Document ED 166 010, 1976.
Activities focus on forms of energy, availability of resources, natural laws and socioeconomic considerations appropriate for middle school and junior high school students.

44. _____. Energy and Man's Environment Activity Guide: An Interdisciplinary Teacher's Guide to Energy and Environmental Activities, Section Two - Uses of Energy. U.S. Educational Resources Information Center, ERIC Document ED 166 011, 1976.
Activities focus on awareness, conservation and planning. Useful for middle and junior high school students.

45. _____. Energy and Man's Environment Activity Guide: An Interdisciplinary Teacher's Guide to Energy and Environmental Activities, *Section Three - Conservation of Energy*. U.S. Educational Resources Information Center, ERIC Document ED 166 012, 1976.

Activities focus on understanding conservation processes, efficiencies, socioeconomic costs, and personal decision-making. Middle and junior high school students.

46. _____. Energy and Man's Environment Activity Guide: An Interidsciplinary Teacher's Guide to Energy and Environmental Activities, Section Four - Impacts of Energy. U.S. Educational Resources Information Center, ERIC Document ED 166 013, 1976.

Activities focus on the socioeconomic effects of energy uses, crisis, and the understandings needed to assess those effects. Middle and junior high students.

47. _____. Energy and Man's Environment Activity Guide: An Interidsciplinary Teacher's Guide to Energy and Environmental Activities Section Five - Limits. U.S. Educational Resources Information Center, ERIC Document ED 166 014, 1976.

Activities relate to understanding natural limits to growth, personal consumption practices, and the social and technological implications of rapidly depleting the world's natural resources. Middle and junior high school students.

48. _____. Energy and Man's Environmental Activity Guide: An Interdisciplinary Teacher's Guide to Energy and Environmental Activities Section Six - Future. U.S. Educational Resources Infomation Center, ERIC Document ED 166 015, 1976.

Activities relate principally to the more advanced technologies and the implications of their development. Middle and junior high school students.

49. Lind, Jackie, and Joe Premo. Energy Education in Elementary Science Curriculum Improvement Study.U.S. Educational Resources Information Center, ERIC Document ED 167 410, October, 1978.

Teacher's manual designed to be used as a supplement to the Teacher's Guide to facilitate using SCIS for energy education in the elementary schools.

50. Magnoli, Michael A. A Composite of Energy Curriculum Guides and Enrichment Materials. U.S. Educational Resources Information Center, ERIC Document ED 134 445, 1975.

Bibliography prepared to provide a listing of a variety of curriculum materials, instructional materials, and reference materials related to energy. Grades K-12.

51. Oklahoma Energy Awareness Education Resource Materials. U.S. Educational Resource Information Center, ERIC Document ED 153 821, 1977.

Teachers reference handbook providing background information and materials. Topics include energy conservation ethics, definitions of energy, forms of energy used by man, future capital requirements for energy and energy conservation in agriculture.

52. Owens, Michael. Energy Education Curriculum Resource. Energy Education Workshop: Energy Sources of the Future. U.S. Educational Resources Information Center, ERIC Document ED 180 827, 1979.

53. Posthuma, Fredrick E. ed. Energy and Education: Teaching Alternatives. U.S. Educational Resources Information Center, ERIC Document ED 154 996, 1978.

Collection of energy education articles for the classroom teacher that suggest activities and projects to be used in the classroom.

54. Posthuma, Fred, and Merle Stephey. Introduction to Energy. Instructional Modules and Transparency Masters. U.S. Educational Resources Information Center, ERIC Document ED 180 791, 1978.

Introductory module for secondary students intended to include a shop or lab component. Useful as teacher information in upper elementary.

55. Science Packets. U.S. Educational Resources Information Center, ERIC Document ED 147 188, September, 1977.

Energy guide for teachers containing discussions and illustrations of five major topics: Sun's radiant energy, solar collection, solar cells, bioconversion (wood, grains, waste), and wind. Concept, discussion-explanation sections and bibliography are included.

56. Solar Energy Education Bibliography. U.S. Educational Resources Information Center, ERIC Document ED 167 391. February, 1979.

An annotoated bibliography listing publications and audiovisual materials devoted to renewable energy sources; sun, wind, water, and biomass.

57. Status of State Energy Education Policy, The. U.S. Educational Resources Information Center, ERIC Document ED 176 969, June, 1979.

A survey was conducted by the Dept. of Energy to determine the status of state policies and practices regarding energy education among state agencies, state offices of energy, governor's offices, and state legislatures.

58. Staub, Joseph R., Jr. Energy Education Resource Guide. U.S. Educational Resources Information Center, ERIC Document ED 179 421, 1980.

An annototated listing of recent curricular materials dealing with some aspects of energy.

59. Teachers Guide to Free and Inexpensive Materials on Energy. U.S.Educational Resources Information Center, ERIC Document ED 175 709, 1978.

Included are listing of books, pamphlets, films, factsheets, magazines, reports, and comic books. Entries are listed on the basis of their relationship to energy as a subject area and their availability at little or no expense.

60. Teacher's Introduction to Energy and Energy Conservation: Elementary, A. U.S. Educational Resources Information Center, ERIC Document ED 127 160, 1975.

Document intended to give elementary school teachers background information and general suggestions for teaching units and correlated learning activities related to energy and energy conservation.

61. Teacher's Introduction to Energy and Energy Conservation: Secondary, A. U.S. Educational Resources Information Center, ERIC Document ED 127 161, 1975.

Background information for teachers to use in energy education.

62. Texas Energy Education Framework. U.S. Educational Resources Information Center, ERIC Document ED 176 957, 1979.
A guide to assist teachers and educational administrators to infuse energy education into the public school curriculum. Four blocks of grade levels, K-3, 4-6, 6-8, 9-12, include; knowledge, application, and values in a multidisciplinary approach.

63. Turkel, Tux. The Maine Teacher's Energy Primer. U.S. Educational Resources Information Center, ERIC Document ED 184 869, 1979.
A guide to familiarize the teacher with the jargon, issues and concepts of energy problems and assist them in preparing a curriculum dealing with these issues.

64. Vocational and Industrial Arts Packets. U.S. Educatonal Resources Information Center, ERIC Document ED 147 187, September, 1977.
Teacher's guide to energy alternatives. Topics include parabolic solar concentrators, solar flat plate collectors, wood as fuel, heat loss, bio-gas, wind, and water. Each of the seven packets contain background information and learning activities.

65. Walker, Harry O. Energy: Options and Issues. U.S. Educational Resources Information Center, ERIC Document ED 149 963, March, 1977.
Provides basic information about energy supply and demand, uses and sources, common terms, history and technological knowledge of energy sources.

B. ENERGY UNITS AND ACTIVITIES

66. Allen, Rodney F. ed. Exemplary Energy Education Lessons for Elementary Students, K-6. U.S. Educational Resources Information Center, ERIC Document ED 186 231, 1980.
A collection of energy lessons assembled from teacher-written units. Each contains background information, objectives, and descriptions of activities.

67. Armitage, Colleen, and others. Idaho Energy Conservation Resource Guide for Environmental Education Grades 7-12. U.S. Educational Resources Information Center, ERIC Document ED 182 134, February, 1979.
Resource guide for twenty-five student activities on environmental and energy education for grades seven through twelve.

68. Augis, Lynne, and others. Priority One: Environment. The Energy Challenge. U.S. Educational Resources Center, ERIC Document ED 133 228, 1975.
Unit is one of a series in environmnetal education for grades 1-12 designed for secondary students. References included.

69. Bakke, Ruth. Energy Conservation Activity Packet, K-2. U.S. Educational Resources Information Center, ERIC Document ED 146 044, 1977.
Book developed to stress an energy conservation ethic and include several values clarifications activities. Teacher is provided with some background information, bibliography and resources.

70. _____. Energy Conservation Activity Packet, Grade 3. U.S. Educational Resources Information Center, ERIC Document ED 146 045, 1977.
Activity packet designed to develop a conservation ethic and includes many values clarification activities. Separated into two parts each contain

background information, concepts and objectives, and activities for each part, bibliographies for teacher and student are included.

71. _____. Energy Conservation Activity Packet, Grade 4. U.S. Educational Resources Information Center, ERIC Document ED 146 046, 1977.
Activity packets for use in grade four. Activities contain background information, concepts and objectives, student and teacher bibliographies, and ditto and transparency masters.

72. _____. Energy Conservation Activity Packet, Grade 5. U.S. Educational Resources Information Center, ERIC Document ED 146 047, 1977.
Activity packet for use in grade five. Activities contain background information, concepts and objectives, student and teacher bibliographies, and ditto and transparency masters.

73. _____. Energy Conservation Activity Packet, Grade 6. U.S. Educational Resources Information Center, ERIC Document ED 146 048, 1977.
Activity packets for use in grade six. Activities contain background information, concepts and objectives, student and teacher bibliographies, and ditto and transparency masters.

74. Beaver, David, and others. Energy Activities for Junior High Science. U.S. Educational Resources Information Center, ERIC Document ED 154 999, April, 1977.
Collection of six energy education activities with the purpose to promote knowledge about energy, provide laboratory experiences, provoke inquiry and relate energy to society through science curriculum.

75. Bell, Ellen. Urban Environmental Education Project, Curriculum Module III: Urban Transportation - Where Are We Going? U.S. Educational Resources Information Center, ERIC Document ED 184 861, July, 1979.
Module containing five activities dealing with transportation in the urban environment. Each activity contains an overview, teacher background information, and pretest.

76. Biglan, Barbara. Urban Environmental Education Project, Curriculum Module I: Energy Generation - Sources and Consequences. U.S. Educational Resources Information Center, ERIC Document ED 184 859, July, 1979.
Module containing five activities dealing with sources and consequences of power production. Each activity contains an overview, teacher background information, and a pretest.

77. Briggs, John, and others. Idaho Energy Conservation Resource Guide for Mathematics, Grades 7-12. U.S. Educational Resources Information Center, ERIC Document ED 182 133, February, 1979.
Resource guide of twenty-five student activities on energy conservation for teaching mathematics from grades seven through twelve.

78. Brown, Evelyn, and others. Energy Transistions in U.S. History, Grades 8-9. Interdisciplinary Student/Teacher Materials in Energy, the Environment and the Economy. U.S. Educational Resources Information Center, ERIC Document ED 179 374, June, 1979.
Unit describing the influence that various sources of energy have had on culture and on understanding energy change.

79. _____. Interdisciplinary Student/Teacher Materials in Energy, the Environment and the Economy: Mathematics in Energy. Grades 8-9.

U.S. Educational Resources Information Center, ERIC Document, ED 167 401, November, 1978.

Part of a series of units produced by NSTA. Teachers manual and student guide attempt to develop necessary mathematical skills needed to understand quantitative facts about energy.

80. Canipe, Stephen L. Crisis Game. U.S. Educational Resources Information Center, ERIC Document ED 181 417, 1977.

A game designed to present children with a vocabulary of energy related terms and an immediate use and reinforcement of those terms in a low-risk game situation. Included are directions, illustrations, and answer keys.

81. Childs, Barbara, and others. Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy: 3, Energy, Engines, and the Industrial Revolution, Grades 8,9. U.S. Educational Resources Information Center, ERIC Document ED 153 843, October, 1977.

Five lessons making up an instructional unit combining science and social science in a look at the broad social and economic upheavals that took place during the industrial revolution, giving special emphasis to the role of energy.

82. _____. Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy: 4, Transportation and the City, Grades 8,9. U.S. Educational Resources Information Center, ERIC Document ED 153 844, October, 1977.

Four lessons designed to fit into existing U.S. History and Civics courses. Activities relate to how the availability and the acceptance of the automobile effect our cities.

83. Bloch, Lenore, and others. Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy: 5, Community Workers and the Energy They use. Grade 2. U.S. Educational Resources Information Center, ERIC Document ED 153 845, October, 1977.

An instructional unit consisting of four lessons to show the relationships of energy and the livelihood of the people of a community. Each of the lessons contain teacher background readings, objectives, teaching strategies, and related activities.

84. _____. Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy: 6, The Energy We Use, Grade 1. U.S. Educational Resource Information Center, ERIC Document ED 153 846, October, 1977.

Instructional unit consisting of nine lessons on energy, with each containing student and teacher materials.

85. Construction of a Model Solar Building. A Learning Experience for Coastal and Oceanic Awareness Studies. No. 318 (Project COAST). U.S. Educational Resources Information Center, ERIC Document, ED 141 164, 1974.

Activity designed for secondary school students to construct a model solar building, includes consideration of principles such as; nature of heat, light, electricity, and energy conservation. Also included are a description of needed materials and equipment, construction tips, diagrams, to assist procedures, suggested use of model and references.

86. Coon, Herbert L. and Mary Lynne Bowman. Energy Activities for the Classroom. Volume II. U.S. Educational Resources Information Center, ERIC Document ED 173 072, December, 1978.

Resource book containing descriptions of over 100 classroom activities designed to illustrate concepts relating to energy, its production, characteristics, use, and conservations. An annotated bibliography is included.

87. Day, John, and Kenneth P. Weeden. Western Coal, Boom or Bust? Grades 9-11. Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy. U.S. Educational Resources Information Center, ERIC Document ED 179 375, June, 1979.

Discusses the advantages and disadvantages of using coal as an option to the energy crisis.

88. Energy Challenge: An Activity Master Program About Our Energy Past, Present, and Future for Grades 5 through 8, The. U.S. Educational Resources Information Center, ERIC Document ED 167 416, 1978.

Twenty-four spirit duplicating activity masters and background materials for energy education. Six units are presented with objectives, background information and vocabulary.

89. Energy Conservation Activities for the Classroom K-12. U.S. Educational Resources Information Center, ERIC Document ED 161 727, 1978.

Eighty-six activities including; title, concept, objectives, subject, level, time involved, materials, procedures, and related career activities.

90. Energy Conservation Activities Grades 1-6. U.S. Educational Resources Information Center, ERIC Document ED 160 407, 1977.

Collection of energy activities that can be used with daily lesson plans and the existing school curriculum.

91. Energy In Our Society. U.S. Educational Resources Information Center, ERIC Document ED 153 871, 1977.

A series of thirteen original classroom instructional packets and four packets developed by NSTA. Materials are interdisciplinary in approach.

92. Energy Systems - Present, Future: Extra-Terrestrials, Grades 7,8,9/Science. U.S. Educational Resources Information Center, ERIC Document ED 186 282, April, 1980.

Major emphasis of lessons is on the energy flow-through systems through the use of role playing of outer space visitors who seek to understand energy conversion principles on earth.

93. Environmental Education, Energy-Technology, Grades 7-12. U.S. Educational Resources Information Center, ERIC Document ED 130 822, 1975.

Activities are related to energy technology and are interdisciplinary in approach. Supplementary references are listed.

94. Environmental Education, Energy-Transportation, Grades K-8. U.S. Educational Resources Information Center, ERIC Document ED 130 821, 1975.

Activities relating to energy transportation. Interdisciplinary in approach, the activities are taken from the subjects of science, art, social studies, mathematics. language arts, English, manual arts, health, and guidance. Supplementary references.

95. Environmental Education, Energy-Society Grades 4-12. U.S. Educational Resources Information Center, ERIC Document ED 130 831, 1975.

One of three in a series of energy related units selected from "Environment and the Quality of Life," seies. Activities are interdisciplinary and resources are included.

96. Environment 1 Education. Values for the Future: Energy. Grades 6-8. U.S. Educational Resources Information Center, ERIC Document, ED 149 987, 1977.

Booklet is one in a series of environmental education for grades K-12. It deals with the effect of culture in determining energy needs, energy loss and forms of energy.

97. Gause, S. Crouther. Poetry and Energy. U.S. Educational Resources Information Center, ERIC Document ED 175 713, 1978.

A booklet designed for seventh grade above average students to explore energy through poetry. A list of free or inexpensive materials and their sources is provided.

98. Hack, Nancy and others. Selected Energy Education Activities for Pennsylvania Middle School Grades. Draft. U.S. Educational Resources Information Center, ERIC Document ED 174 479, 1979.

Activities intended to help increase awareness and understanding of the energy situation and to encourage students to become energy conservationists.

99. Higdem, Mary and others. Idaho Energy Conservation Resource Guide for Science, Grades 7-12. U.S. Educational Resources Information Center, ERIC Document ED 182 135, February, 1979.

Resource guide of twelve student activities on energy conservation for science students grades 7-12.

100. How We Make Energy Work: Grades 4,5,6 Science. U.S. Educational Resources Information Center, ERIC Document ED 186 281. April, 1980.

Four units designed to focus on the technological aspects of energy. Each unitcontains; basic concepts and applications, steps and processes of energy production and transmission, fuel acquisition, and energy futures.

101. Humer, Barbara. Mathematics and Solar Energy. Solar Energy Education Project. U.S. Educational Resources Information Center, ERIC Document ED 179 792, 1979.

A learning module for junior high school students dealing with basic career awareness in the energy field and basic principles and aspects of energy use.

102. Hudson, Paula. Student's Sympathetic Participation in the Energy Crisis. U.S. Educational Resources Information Center, ERIC Document ED 175 719, 1978.

A collection of ten lessons in English skills, allowing seventh grade students to use verbal, research, and creative skills in discussing the energy situation as it applies to their lives. A source list of free or inexpensive materials is provided.

103. Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy. Energy and Transportation, Grade 3. Draft copy. U.S. Educational Resources Information Center, ERIC Document ED 167 402, December, 1977.

Part of a series of units produced by NSTA. It presents the variety of transportation modes and tries to promote an understanding of the effects transportation and fossil fuel consumption have on the world.

104. Johnson, Bette, and Olivia Swinton. Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy. Networks: How

Energy Links People, Goods and Services. Grades 4,5. U.S. Educational Resources Information Center, ERIC Document ED 153 859, February, 1978.
This unit investigating a simple energy network and makes an analogy with similar mutually supporting networks in the natural and man-made world.

105. _____. Networks: How Energy Links People, Goods and Services, Grades 4,5. Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy. U.S. Educational Resources Information Center, ERIC Document ED 182 180, June, 1979.
A unit investigating a simple electrical distribution network in the natural and man-made world.

106. Land, Amy A. Energy Awareness: An Introduction to the Energy Situation. U.S. Educational Resources Information Center, ERIC Document ED 175 711, 1978.
Series of classroom activities designed to help students become more aware of the enrgy situation and their individual responsibilites toward it.

107. _____. Energy Conservation. U.S. Educational Resources Information Center, ERIC Document ED 175 712, 1978.
Selection of class activities to aid students in learning the concepts of energy conservation and put knowledge into practice. Activities include motivational hints, lesson purpose, materials, instructions and a list of free and inexpensive materials.

108. Lay, Gary A., ed. and Donald McCurdy, ed. Basic Teaching Units, BTU's on Energy. Nebraska Energy Conservation Plan. U.S. Educational Resources Information Center, ERIC Document ED 179 395, 1978.
Collection of 21 teaching units designed for use in energy education within various disciplines of the secondary curriculum.

109. Lendsey, Jacqueline L. and others. Two Energy Gulfs, Grade 6-7. Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy. U.S. Educationl Resources Information Center, ERIC Document ED 179 351, March 1979.
This text focuses on coastal oil production of the Persian Gulf and the Gulf of Mexico. It is designed for use in social studies and math, withthe interdependence of people and energy emphasized.

110. Let's Learn About Energy, Module A Pilot Form. U.S. Educational Resources Information Center, ERIC Document ED 180 803, 1976.
Fourth grade booklet defining energy and examining simple machines. Laboratory activities and a values exercise are included.

111. Man and Energy, Module C, Fourth Grade. Pilot Form. U.S. Educational Resources Information Center, ERIC Document ED 180 805, 1976.
Fourth grade booklet investigating solar energy, ecology and fossil fuels. Laboratory activities and values exercises.

112. Mason, Jack L. and Joseph S. Cantrell. Solar Energy: A Middle School Unit. Environmental Education Occasional Paper No. 2. U.S. Educational Resources Information Center, ERIC Document ED 183 392, February, 1979.
A collection of teaching activities in solar energy education for middle school students.

113. McCurry, Niki, and others. Idaho Energy Conservation Resource Guide for Language Arts, Grades 7-12. U.S. Educational Resources Information Center, ERIC Document ED 182 136, February, 1979.
Resource guide of student activities on energy conservation for language arts, grades 7-12.

114. McReynolds, Mildred. Energy for the Future. U.S. Educational Resources Information Center, ERIC Document ED 175 715, 1978.
A collection of lessons for sixth grade students using reading and language skills to help them become interested in the energy future and develop personal values. Special attention is given to consevation and development of alternative energy sources. A list of supplementary activities and free or inexpensive materials is included.

115. Nature's Energy Module B, Fourth Grade. Pilot Form. U.S. Educational Resources Information Center, ERIC Document ED 180 804, 1976.
Booklet examining man's use of fossil fuels, electricity production, and other energy sources. Laboratory activities and values exercises.

116. Nixon, Ila. Ernie Erg's Second Primer on the Economics of the Energy Crisis. U.S. Educational Resources Information Center, ERIC Document Document ED 134 442, 1975.
Unit to teach about scarce resources and to relate them to basic economics and energy conservation. It is hoped the student will gain enough information about present and emerging sources of energy to enable them to analyze the problems, make some decisions at their own different levels of ability and motivate the them to become energy conservation activitists. Elementary and secondary level.

117. Nous, Albert P. Urban Environmental Education Project, Curriculum Module II: Energy Conservation - What are the Options? U.S. Educational Resources Information Center, ERIC Document ED 184 860, August, 1979.
This module contains five activities dealing with energy conservation in the urban environment.

118. O'Brien, Alexander. Crisis - Energy. Solar Energy Education Project. U.S. Educational Resources Information Center, ERIC Document ED 179 795, 1979.
A learning module dealing with the overall U.S. energy system including resources, consumption rates, governmental plans, and regulations energy/conservation problems and techniques, and programs. Pre and post-tests, activities, vocabulary lists and diagrammatic presentations are included.

119. Oklahoma Energy Awareness Education, Energy Education Activities, Grades K-3. U.S. Educational Resources Information Center, ERIC Document ED 153 820, 1977.
Activities contain purpose concept or objective, materials and activity description. They involve students in games, values clarification and independent investigations.

120. Oklahoma Energy Awareness Education, Energy Activities, Grades 4-12. U.S. Educational Resources Information Center, ERIC Document ED 153 820, 1977.
Activities provide an interdisciplinary approach to energy education. Grade level, objective, materials, and descriptions are given for each activity which include laboratory experiences, values clarification exercises, games, and independent studies.

121. Our World of Energy: An Interdisciplinary Curriculum Program for Elementary Schools. Teacher's Guide, Student Manual, 3 Filmstrips, and 3 Audio Cassette Tapes. U.S. Educational Resources Information Center, ERIC Document ED 153 872, 1977.

Collection of instructional materials for energy education in the elementary school. These materials are designed to introduce in an interdisciplinary manner to energy issues and to show them what energy is, where it comes from, and what we can do about the energy crisis.

122. Owens, Jo Ann. Basic Energy Overview. U.S. Educational Resources Information Center, ERIC Document ED 175 714, 1978.

A collection of lessons for fifth-grade above average achievers. They are designed to help them understand the importance of conserving energy and their role in the involving energy situation. A list of free or inexpensive resources is provided.

123. Parr, Donald. Energy Future...(Project ECOLogy ELE Pak, Parr Pak). U.S. Educational Resources Information Center, ERIC document ED 133 162, 1976.

One of a series developed by Highline Public School for junior high students. Eleven lessons including concept of the lesson, materials needed, notes to the teacher, procedure, evaluation activities and suggested additional activities are included.

124. Polk, Joyce. Solar Energy - Solution or Pipedream. U.S. Educational Resources Information Center, ERIC Document ED 175 716, 1978.

Series of lessons and class activities intended to provide students in advance science classes with awareness of the possibilities and limitations of solar energy as a potential solution to the energy crisis.

125. Premo, Joe, and others. Energy Education in Elementary Science: Elementary Science Study. U.S. Educational Resources Information Center ERIC Document ED 167 409, October, 1978.

ESS units were examined and outlined for energy education concepts. Activities were added to develop energy exploration, labeling and application.

126. Schmidt, Joan S. and others. Conservation Activities for Urban Elementary Students K-6. U.S. Educational Resources Information Center, ERIC Document ED 191 743, 1980.

Simple activities, experiments and demonstrations relating to energy conservation in the home are presented. Activity and game masters provided.

127. Science Activities: Chemical Energy 1977. U.S. Educational Resources Information Center, ERIC Document ED 152 529, 1977.

Energy package containing fifteen activities relating to chemical energy that illustrate principles and problems relating to energy, useful in fourth, fifth, and sixth grades.

128. Science Activities in Energy: Conservation. U.S. Educational Resources Information Center, ERIC Document ED 152 531, 1977.

Fourteen activities relating to energy conservation, useful in fourth, fifth and sixth grades.

129. Science Activities in Energy: Electrical Energy. U.S. Educatioanl Resources Information Center, ERIC Document ED 152 530, 1977.
Sixteen activities relating to electrical energy. The activities are simple, concrete experiments for fourth, fifth, and sixth grade students.

130. Science Activities: Solar Energy. U.S. Educational Resources Information Center, ERIC Document ED 152 532, 1977.
Twelve activities relating to solar energy. Simple concrete activities useful for fourth, fifth, and sixth grade students.

131. Science Activities in Energy: Wind Energy. U.S. Educational Resources Information Center, ERIC Document ED 170 133, 1978.
Science activities energy packet with twelve activities related to wind energy.

132. Smith, Thomas W. and John Jenkins. The Household Energy Game. U.S. Educational Resources Information Center, ERIC Document ED 123 035, December, 1974.
The Household Energy Game has been developed to provide some indication of energy use and individual management. The game is divided into two sections. In the first section one is to devise one's own energy budget. Part two is concerned with ways to modify a budget to save energy.

133. Smith, Victor A. and Kathleen Ruddy Lane. An Evaluation of the Energy Education Curriculum Project Materials in Indiana Elementary Schools. U.S. Educational Resources Information Center, ERIC Document ED 186 256, April, 1980.
An evaluation of a K-6 collection of energy education materials dealing with social studies and science classes.

134. Solar Energy Education Packet for Elementary and Secondary Students Revised Edition. U.S. Educational Resources Information Center, ERIC Document ED 173 073, March, 1979.
Packet used to introduce the student to solar energy, facts terminology and background through alternate reading assignments, activities and experiments.

135. Williams, LaVora. An Energy Encounter (An Energy Awareness Program). U.S. Educational Resources Information Center, ERIC Document ED 175 718, 1978.
A guide for seventh grade students to devise and operate booths and activity centers to be presented to the community. A source list of free and inexpensive materials is provided.

136. _____. My Very Own Contract About the Energy Crisis. U.S. Educational Resources Information Center, ERIC document ED 175 717, 1978.
A collection of lessons and class activities for seventh grade students to teach them methods for acquainting others of the nature of the energy situation and methods of making their homes more energy efficient. A source list of free and inexpensive materials is also provided.

C. ENVIROMENTAL EDUCATION CURRICULUM GUIDES

137. Abbott, Verlin M. "Boomsville to Doomsville" - Development of Industry Within a Community. Enviromental Ecological Education Project. U.S. Educational Resources Information Center, ERIC Document ED 099 213, July, 1973.

A junior high school unit devised to discuss the pros and cons of industry moving into a community. It also includes objectives, test and suggested resources.

138. _____. The Changing Scene - A short History of the Parkway Area. Enviromental Ecological Education Project. U.S. Educational Resources Information Center, ERIC Document ED 099 212, June, 1972.

An elementary unit designed to introduce students to the people and events of the past that help shape the cummunity of Parkway, Missouri. It includes objectives and tests for the K-3 and 4-6 grade levels.

139. _____. The Classroom as a Minature Society. Enviromental Ecological Project. U.S., Educational Resources Information Center, ERIC Document ED 100 650, June, 1972.

Unit devised for use in fifth and sixth grade classes to help with the understanding of society's effect on the enviroment. Ten concepts are developed with objectives and evaluating instruments.

140. _____. Communication: Within the School Site, Community and Area into Space. Enviromental Ecological Education Project. U.S., Educational Resources Information Center, ERIC Document ED 099 211, June, 1972.

A unit devised for primary grades K-3, including various aspects of communication which are studied through the environmental resources at the school site and the community.

141. _____. Communities in Nature. Enviromental Ecological Education Project. U.S., Educational Resources Information Center, ERIC Document ED 098 073, June, 1972.

An ecological approach to the study of communities for primary school children. Concepts discussed include: food chains, food webs, competition, and mutalism.

142. _____. Enviromental and Architectual Influences on Homes. Environmental Ecological Education Project. U.S., Educational Resources Information Center, ERIC Document ED 100 649, June, 1972.

This unit is designed for grades four and five, and focuses on houses and how they have influenced man, or how man has influenced them.

143. Alternatives for Man and Environment, Revised Curriculum. U.S., Educational Resources Information Center, ERIC Document ED 071 856 1972.

A one-year general education course built on the idea that an interdisciplinary, module structured course represents one of the better approaches to planning an environmental education curruculum.

144. An Outline for Teaching Conservation in Elementary Schools. U.S., Educational Resources Information Center, ERIC Document ED 067 225, July, 1971.

This elementary guide stresses the relationship between man and his physical-biological environment in a social-cultural contex. Field study is emphasized along with individual instruction, problem solving, and the use of a variety of materials.

145. Animals. Environmental Education Curriculum. U.S., Educational Resources Information Center, ERIC Document ED 097 209, November, 1973.

This upper elementary unit helps students to better understand and appreciate the variety of animals living today, their roles in nature, and man's influence on these animals. It also includes evaluation instruments, appendices of teaching aids, and field trip guidelines.

146. Archbald, David. Environmental Education, Curriculum and Teaching Activities. U.S., Educational Resources Information Center, ERIC Document ED 042 607, 1970.

A curriculum guide and collection of teaching activities for a K-12 program in environmental education. The program is based on forty-four concepts which are broken down into subthemes; economics and culture, ecology, and management.

147. Baker, Thomas M. and John F. Reiher, Equinox. A Model for the Environmental Education Curriculum for Kindergarten Through Grade Twelve in Delaware Schools. U.S., Educational Resources Information Center, ERIC Document ED 123 034, January, 1975.

This state model defines environmental education, lists objectives and guidelines, and stresses the need for an interdisciplinary approach. The global objectives include energy sources, earth resources, resource reclamation, population dynamics, and interdependance and quality of life.

148. Bear Creek, Alabama - Teachers' Workshop in Environmental Education. U.S., Educational Resources Information Center, ERIC Document ED 077 695 June, 1971.

Methods and techniques for teaching in the out-of-doors were identified and lesson plan developed for the following curriculum areas: science, language arts, social studies, creative arts, and mathematics. Elementary.

149. Bedwell, Lance. Environmental Education Handbook for Teachers. U.S., Educational Resources Information Center, ERIC Document 125 888, 1976.

This handbook is designed as a guide for teachers desiring to develop an environmental curruculum, or to expand an existing one. It presents a rationale for developing the program, including guidelines for achieving this goal at all grade levels.

150. Bennett, Dean B., and Wesley H. Willink. Environmental Education Teacher's guide: Composite K-6. U.S., Educational Resources Information Center, ERIC Document ED 121 568 1975.

This guide is designed to familiarize teachers with how an enviromental education program can help their teaching and in achieving the goals of their school by developing attitudes towards study environments and associated environmental problems.

151. Bloch, Lenore, and others. Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy: The Energy We Use, Grade 1. U.S., Educational Resources Information Center, ERIC Document ED 153 846, October, 1977.

This unit contains a set of nine lessons on energy for the use in grade 1. Each lesson contains complete teacher and student materials with reading and language skills reinforced in each activity.

152. Brown, William E. Environmental Education Manual for New Mexico Teachers. U.S., Educational Resources Information Center, ERIC Document ED 116 947, November 1970.

This booklet is a guide for New Mexico teachers to incorporate environmental education into existing curricular. Elementary level.

153. Budde, Duane. Mounds View Environmental Education Project, Report # 1. U.S., Educational Resources Information Center, ERIC Document ED 063 162, 1971.

This collection of ideas, activities, and unit plans from the Mounds View Project would be useful for junior and senior high school teachers and curriculum planners.

154. Campbell, Bruce. Energy and Education Handbook. U.S., Educational Resources Information Center, ERIC Document ED 009 981, October 1977.

A curriculum model for all teachers from kindergarten to secondary school with four teaching units provided for the differentiation of instruction..

155. Career Education in the Environment. A Handbook. U.S., Educational Resources Information Center, ERIC Document ED 063 471, 1971.

A handbook designed for secondary school use in the exploring of environmental problems and solutions, and providing information on existent and emerging career opportunities.

156. Claasen, Bernard L., and David V. McCalley. Environmental Education Process for Iowa Schools. U.S., Educational Resources Information Center, ERIC Document ED 164 346, 1978.

This publication provides a framework and perspective on which development of environmental education programs may be established. It describes how present programs may be modified and lists examples that would guide teachers to develop their own activities.

157. Designing an Environmental Curriculum...A Process. U.S., Educational Resources Information Center, ERIC Document ED 115 498, 1975.

This booklet presents a step-wise sequence for incorporating environmental objectives into any instructional program.

158. Dowd, Patricia. An Urban Environmental Education Curriculum Guide for a Sixth Grade Teacher in Irvington. U.S., Educational Resources Information Center, ERIC Doucment ED 164 341, June, 1978.

This study investigates a strategy for integration of a comprehensive urban environmental education program into an existing school curriculum.

159. East Syracuse-Minoa Schools Environmental Education Materials, Middle School Package, Grade 7--Science. U.S., Educational Resources Information Center, ERIC Document ED 101 940, 1973.

This series of five environmental education units is designed around concepts of survival, interdependence, scarcity, recyclement, rights vs. responsibility, planning valuing, social forces and optimism.

160. East Syracuse-Minoa Schools Environmental Education Materials, Middle School Package, Grade 6--Science and Social Studies. U.S., Educational Resources Information Center, ERIC Doucment ED 101 941, 1973.

The first of these two environmental units deals with Science and the ecology along a creek. The second unit, a social studies unit, illustrates the environmental concepts associated with the MACOS program.

161. East Syracuse-Minoa Schools Environmental Education Materials, Middle School Package, Grade 7--Science. U.S., Educational Resources Information Center, ERIC Document ED 101 942, 1973.

This series of five environmental units are designed around such skills as; notetaking, organizing information, critical thinking, analzsis of data, and scientific skills. These skills along with content material help the student better understand his role in the environment.

162. East Syracuse-Minoa Schools Environmental Education Materials, Middle School Package, Grade 8--Social Studies. U.S., Educational Resources Information Center, ERIC Document ED 101 943, 1973.

This eighth grade unit was designed around three themes; habitation patterns, economic and technical development, and changing role of government.

163. East Syracuse-Minoa Schools Environmental Education Materials, Middle School Package, Middle School Crossover Units. U.S., Educational Resources Information Centers, ERIC Document ED 101 944, 1973.

This series of five units are designed for teachers use at the middle school level. They consist of two crossover units (a science to social studies, and social studies to science), a math skills unit, a language arts unit, and a guide for outdoor educational activities.

164. East Syracuse-Minoa Schools Environmental Education Materials, High School Package. U.S., Educational Resources Information Center, ERIC Document ED 101 945, 1973.

This series consists of four units: The first deals with advanced science and independent study, the second an ecology course, the third an environmental biology unit, and the fourth deals with environmental physics.

165. Edwards, Willian C., and Robert J. Larson. Environmental Activities, Junior High Scool. U.S., Educational Resources Information Center, ERIC Document ED 099 214, 1973.

This guide is aimed at helping our youth become more knowledgable concerning the environment and associated problems, helping to make them aware of how to solve these problems, and motivating them to work toward their solutions.

166. Elementary Environmental Education. U.S., Educational Resources Center, ERIC Document ED 080 368, 1973.

This curruculum for grades one through six places special emphasis on the ecological implications of man's activities.

167. Energy and You. Environmental Education Curriculum. U.S., Educational Resources Information Center, ERIC Document ED 101 937, January, 1974.

This unit is designed to develop an understanding of energy and the need for it, and to understand some of the causes, effects, and solutions of the energy crisis. These ideas are an attempt to reach educable mentally retarded.

168. Enjoying the Environment. Environmental Education Curriculum. U.S., Educational Resources Information Center, ERIC Document ED 097 211, March, 1974.

This unit is designed to provide enough information and skill development to enable educable mentally retarded students at the intermediate and junior high level to successfully participate in some outdoor activities.

169. Environmental Activities. Environmental Education Curriculum. U.S., Educational Resources Information Center, ERIC Document ED 097 210, May 1974

The material is intended as a source from which primary teachers may select activities from several generalized groups of ideas.

170. Environmental Education, Conceptual Curriculum Framework. U.S., Educational Resources Information Center, ERIC Document ED 127 115, 1973.

These materials are the result of a study that includes all areas of the curruculum, kindergarten to grade twelve and beyond. Four major areas are covered: the geosphere, the energysphere, the sociosphere, and the biosphere.

171. Environmental Education Curriculum Development, Grades K-1, for St. Martin Parish. U.S., Educational Resources Information Center, ERIC Doucment ED 100 676, 1974.

This environmental education curriuclum guide is designed for teachers use in kindergraten and first grade. It includes six units developed to disucss environmental concepts related to the bio-physical environment.

172. Environmental Education Curruculum Development, Grade 6, for St. Martin Parish. U.S., Educational Resources Information, ERIC Document ED 100, 712, 1974.

This environmental curriculum guide is designed for teacher use in the sixth grade. There are sever units discussed; environmental relationships, wildlife and related problems, resources, and pesticide problems.

173. Environmental Education Curriculum Guide for Intermediate Social Studies. U.S., Educational Resources Information Center, ERIC Document ED 080 367, 1973.

These instructional materials are designed to give specific emphasis to the ecological implications of man's activities as generally explored in the social studies curricula for grades four through six.

174. Environmental Education Curriculum Guide, Grades 1-12. Experimental Draft. U.S. Educational Resources Information Center, ERIC Document ED 081 641, July 1973.

These activities are experimental in nature and it is suggested that they be developed in the order of exploration, discussion, and application.

175. Environmental Education Guide K-12. U.S. Educational Resources Information Center, ERIC Document ED 125 862, July, 1974.

This educational program intends to promote a universal view of the environment through interdisciplinary activity-centered experiences. The objective is to help the student examine environmental relationships, acquire problem-solving skills, and develop civil responsibility and values.

176. Environmental Education Handbook. U.S. Educational Resources Information Center, ERIC Document ED 125 871, December, 1972.

This handbook is designed to help educators develop an environmental curriculum for their school districts. It also includes teaching units, background information, and appropriate activities.

177. Environmental Education Values for the Future: Curriculum, Population, Environmental Ethics, Environmental Decisions, Economics, Ecosystems, Energy and Technology, Packet K-2. U.S. Educational Resources Information Center, ERIC Document ED 149 979, 1977.

This is one of a series of environmental education booklets for students in grades K-12. The major goal of scientific literacy is developed by dividing the program into seven concepts areas, and include introductory material, behavorial objectives, and activity options.

178. Environmental Education Values for the Future: Curriculum, Population, Environmental Ethics, Environmental Decisions, Economics, Ecosystems, Energy, and Technology. Packet 3-5. U.S. Educational Resources Information Center, ERIC Document ED 149 980, 1977.

This booklet is one of a series of environmental education booklets for students in grades K-12. The goal of environmental literacy is hopefully achieved by the use of introductory materials, objectives, appropriate subject areas, and activity options.

179. Environmental Education, Values for the Future: Curriculum, Grades 6-8 and 9-12. U.S. Educational Resources Information Center, ERIC Document ED 149 981, 1977.

This booklet on curriculum is one of a series in environmental education for grades K-12. In this section four basic concepts are listed along with objectives, appropriate subject areas, key words and definitions, activity options, materials and resources.

180. Exploring Careers in Environmental Protection. U.S. Educational Resources Information Center, ERIC Document ED 106 575, 1973.

This career exploration program for grades 9-10 is part of a comprehensive K-10 program attempting to develop an awareness and appreciation for work. It contains a collection of materials in the form of student packets, a resource list, and teaching strategies designed to introduce the student to possible career opportunities.

180. Exploring Careers in Environmental Protection. U.S. Educational Resources Information Center, ERIC Document ED 106 575, 1973.

This career exploration program for grades 9-10 is part of a comprehensive K-10 program attempting to develop an awareness and appreciation for work. It contains a collection of materials in the form of student packets, a resource list, and teaching strategies designed to introduce the student to possible career opportunities.

181. Field Learning Activities. U.S. Educational Resources Information Center ERIC Document ED 080 366, 1973.

This collection of seventy field activities are designed for elementary and junior high students. The activities cover such areas as; science, social science, language arts, health, history, mathematics, and art.

182. Fox, Carla, and others. Project Ranger Curriculum Guide. U.S. Educational Resources Information Center, ERIC Document ED 187 485, June, 1978.

This curriculum guide is designed to be a manual for school districts and other organizations interested in implementing a program to improve school behavior and academic performance of selected, primarily "disruptive" students who are failing traditional school programs. Focus is on program activities and student counseling techniques.

183. Geology and Our Environment. Environmnetal Education Curriculum. Revised. U.S. Educational Resources Information Center, ERIC Document ED 097 214, June, 1974.

This unit is constructed to expose secondary students to the forces that have determined the topography of as area, data on and field experience on fossil collection, variance of rocks and fossils in different areas, and how this affects a city dweller's life through such examples as zoning decisions and considerations in purchasing a home.

184. Gises, Ronald L., and others. Environmental Education for the Seventies. U.S. Educational Resources Information Center, ERIC Document ED 106 090, September, 1973.

This collection of materials is divided into five sections: the philosophy and concepts of environmental education and program development, lesson plans and teaching methods, resources, teaching aids and bibliography, and environmental films.

185. Guide for Integrating Environmental Education Concepts Into Elementary, Secondary, and Post-Secondary Vocational, Technical, and Adult Education, Final Draft. U.S. Educational Resources Information Center, ERIC Document ED 106 066, January, 1974.

This guide uses the United States Office of Education cluster concept as a framework. It covers such areas as accounting, agriculture, automotive, carpentry, drafting, home economics, horticulture, management, nursing, and social studies. Behavorial objectives, learning activities, classroom and reference materials are also included.

186. Helfrich, Carl, and others. This Land is Your Land. The Problem of Land Utilization. Environmental Ecological Education Project. U.S. Educational Resources Information Center, ERIC Document ED 099 210, 1973.

This unit for seventh grade students focuses on the variety of factors involved in land usage; the way man has used this land, the influence of surface features, socio-cultural factors, and natural disastors--particularly in regard to improper land use. Also included are objectives, teaching methods, resources, and listings of careers in every aspect of land use.

187. Hershey, John T., and others. A Curriculum Activities Guide to Solid Waste and Environmental Studies. U.S. Educational Resources Information Center, ERIC Document ED 080 348, 1973.

This elementary level book is the fourth in a series of student-oriented problem solving related to environmental matters. It is divided into three activity levels; awareness, transitional, and operational, with economic, political, social, scientific, technological, and legal factors considered.

188. _____. A Curriculum Activities Guide to Population and Environmnetal Studies. U.S. Educational Resources Information Center ERIC Document ED 080 349, 1073.

This book is the second in a series of four emphasizing student-oriented problem solving related to environmental matters. It is divided into three activity levels; awareness, transitional, and operational. Four approaches to problem solving are presented; simulation, contract projects, debating, and modeling. Elementary level.

189. _____. A Curriculum Activities Guide to Water Quality Equipment and Environmnetal Studies. U.S. Educational Resources Information Center, ERIC Document ED 080 361, 1973.

The third of a series of four student-oriented problem solving environmental books. The instrumentation presented in this guide should aid students in the construction plans for thirteen pieces of water quality testing equipment and discussions of preassembled kits. Elementary level.

190. _____. A Curriculum Activities Guide to In-Depth Environmental Studies. U.S. Educational Resources Information Center ERIC Document ED 083 004, 1973.

This guide is the last in a series of four student-oriented books in environmental education. The three activity level approaches are intended to provide investigations that will motivate students to pursue studies, generate ideas, design and carry out plans of action, make decisions regarding data collection, processing, evaluation and utilization and determine what potential impact these findings might have on community action. Elementary level.

191. _____. A Curriculum Activities Guide to Water Pollution and Environmental Activities Studies: Activities Appendices Volumes 1 and 2. U.S. Education1 Resources Information Center, ERIC Document ED 154 986, 1972.

A secondary level activity guide divided into four sections dealing with the Hydrologic Cycle, Human Activities, Ecological Perspectives, and Social and Political Factors.

192. _____. A Curriculum Activities Guide to Water Pollution Equipment and Environmental Studies, Volume 3. U.S. Educational Resources Information Center, ERIC Document ED 093 648, September, 1973.

The purpose of this book is to present instructions for construction of low-cost instruments for environmental studies. The instruments discussed were either adapted or designed by students who were presented with the problem of producing low-cost equipment. Sequal to volumes 1 and 2, but can be used independently.

193. _____. A Curriculum Activities Guide to Water Pollution Equipment and Environmental Studies, Volume, 4. U.S. Educational Resources Information Center, ERIC Document, ED 103 196, August, 1973.

This guide was developed for elementary and secondary students, and is one of a series emphasizing student-oriented problem solving related to environmental matters. It is designed to guide others in initiating, continuing, or expanding their environmental education program by awareness and transitional activities.

194. _____. A Curriculum Activities Guide to Birds, Bugs, Dogs, and Weather and Environmental Studies. Volume 5, 2nd edition. U.S. Educational Resources Information Center, ERIC Document ED 093 619, August, 1973.

This guide is intended for use by teachers and students and organized into three sections; awareness, transitional, and operational activities. The format is that so a questioning sequence, using questions to lead to, initiate, continue, and expand the activity.

195. Jacobs, Joel Robert. Fourth Grade: Late Fall and Early Spring Curriculum Guide. U.S. Educational Resources Information Center, ERIC Document ED 068 367, 1972.

This curriculum guide for fourth grade is an activity centered outdoor program. Each activity plan contains an introduction, and student preparation, topics for follow-up and reinforcement, and supplemental resources and aids.

196. _____. Fifth Grade: Winter and Spring Curriculum Guide. U.S. Educational Resources Information Center, ERIC Document, ED 068 368, 1972.

This guide contains activity plans for a fifth grade outdoor education experience. Each plan contains an introduction and student preparation, topics for follow-up and reinforcement, and supplemental resources and aids.

197. _____. Sixth Grade: Fall and Winter Curriculum Guide. U.S. Educational Resources Information Center, ERIC Document ED 068 310, 1972.

This is a curriculum guide for a sixth grade outdoor education experience. Each plan contains classroom introduction and student preparation, topics/projects for follow-up and reinforcement, and supplemental resources and aids.

198. Jungles, Mary R., and others. Environmental Learning Experiences: Bio-Physical, Junior High School. U.S. Educational Resources Information Center, ERIC Docuemnt ED 099 229, 1974.

This curriculum guide for teacher use at the junior high level consists of a set of ideas, activities, and opinions which help generate a positive approach to the environment. Each of the six units contain an introduction instructional objectives, experiences, and references.

199. _____. Environmental Learning Experiences: Socio-Cultural, Junior High School. U.S. Educational Resources Information Center, ERIC Document ED 099 231, 1974.

An environmental education curriculum guide developed for teacher use and designed to encourage an integration of disciplines for an inter-disciplinary approach. It also promotes positive thinking through the seven units included, with each containing an introduction, purpose, objectives, experiences and references.

200. _____. Other Curriculum Areas, U.S. Educational Resources Information Center, ERIC Document ED 099 233, 1974.

This curriculum guide was developed to use in the junior and senior high school. It deals with the integration of environmental education into curricular areas not normally associated with environmental education.

201. Learning to Get Around. An Urban Environment Mapping Unit, U.S. Educational Resources Information Center, ERIC Document ED 107 468, 1971.

This unit helps students visualize his surroundings, read, interpret, and create maps, which develop self-control and sense of personal control over his environment. Elementary level.

202. Life, Past. Present and Future. Environmental Education Curriuclum Project. U.S. Educational Resources Information Center, ERIC Document ED 097 215, January, 1974.

This unit attempts to interrelated the traditional biological science studies such as food webs, population changes and ecological succession to form a coherent picture of our world today, the factors that create it and the forces that continue to change it. Designed for use in the secondary school and built around nine films into seven basic topics.

203. Linder, Alice D. Environmental Education: A Source Book for Educators. U.S. Educational Resources Information Center ERIC Document ED 123 095, 1976.

This curriculum guide presents a plan to implement an environmental education program. The main objective of the program is to develop environmental literacy including skills of inquiry, problem solving, managing and communication, knowledge of environmental interrelationships, and positive attitudes and values toward environmental problems and their solutions.

204. Living Forest, Environmental Ecological Education Project, The. Revised. U.S. Educational Resources Information Center, ERIC Document, ED 097 221, June, 1972.

This unit designed for intermediate grades of elementary schools, focuses on the living forest by presenting such concepts as succession, forest communities, adaptation, ecological interrelationships, animal animal populations, the impact of man on forests, and job opportunities for the forest industry.

205. Lundstrum, Donald, and others. Environment--A Way of Teaching (Grades K-12). U.S. Educational Resources Information Center, ERIC Document ED 063 989, 1971.

Resource information and ideas for curriculum programs related to the study of the environment are presented in this resource guide for elementary and secondary teachers.

206. Mary, Charlotta B. Adventures in Ecological Reading, Language Arts (Experimental); 5365.02. U.S.Educational Resources Information Center ERIC Document ED 086 529, 1972.

A reading-discussion, activities-experiences course with group and individual projects and experiments especially recommended for students interested in ecology and/or related sciences. Special emphasis is placed on Marine Science.

207. McCabe, Robert H., and others. Man and Environment Teaching Alternatives. U.S. Educational Resources Information Center, ERIC Document ED 144 826, June, 1977.

This material is intended to expand the format of the "Man and Environment Revised Curriculum" by making this more useful for teachers to teach the various topics.

208. Multidisciplinary Process Curriculum in Environmental Education, Grade 1, A. U.S. Educational Resources Information Center, ERIC Document ED 099 216, 1973.

A first grade curriculum guide including activities, guidelines for field trips, and a resource section. Topics discussed are animals, air, water, and litter.

209. Multidisciplinary Process Curriculum in Environmental Education Grade 2, A. U.S. Educational Resources Information Center, ERIC Document ED 099 217, 1973.

A second grade curriculum guide including activities, guidelines for field trips, and a resource section. Topics discussed include, plants, soil and litter.

210. Multidisciplinary Process Curriculum in Environmental Education Grade 3, A. U.S. Educational Resource Information Center, ERIC Document ED 099 218, 1973.

A third grade curriculum guide including activities, guidelines for fieldtrips, and a resource section. The activities are organized to promote awarness, man's use and problem solving.

211. Multidisciplinary Process Curriculum in Environmental Education Grade 4, A. U.S. Educational Resources Information Center, ERIC Document ED 099 219, 1973.

A fourth grade curriculum guide including activities, guidelines for fieldtrips, and a resource section. The activities are organized to promote awareness, man's use, and problem solving.

212. Multidisciplinary Process Curriculum in Environmental Education Grade 5, A. U.S. Educational Resources Information Center, ERIC Document ED 099 220, 1973.

A fifth grade curriculum guide including activities, guidelines for field trips, and a resource section. The activities are organized to promote awareness, man's use, and problem solving.

213. Multidisciplinary Process Curriulum in Environmental Education Grade 6, A. U.S. Educational Resources Information Center, ERIC Document ED 099 221, 1973.

A sixth grade curriculum guide with activities field trip guidelines, and a resource section. Activities are organized to promote awareness, man's use and problem solving which allow students to make observations collect and record data, interpret data, and summarize.

214. Murray State University - Teachers' Workshop in Environmental Education (Youth Station, Land Between the Lakes, August 8-14, 1971). U.S. Educational Resources Information Center, ERIC Document ED 077 696, 1971.

Lessons plans developed by teachers in an environmental workshop include curriculum areas such as science, language arts, mathematics, social studies, art, recreation, and health.

215. Murray State University - Teachers' Workshop in Environmental Education (Audubon State Park, Henderson, Kentucky, June 19-23, 1972). U.S. Educational Resources Information Center, ERIC Document ED 077 697, June, 1972.

Lesson palns developed by teachers in an environmental workshop include curriculum areas such as science, language arts, mathematics, social studies, art, recreation, and health.

216. Murray State University - Teachers' Workshop in Environmental Education (Youth Station, Land Between the Lakes, August 7-12, 1972). U.S. Educational Resources Information Center, ERIC Document ED 077 698, August, 1972.

Lesson plans developed by teachers in an environmental workshop include curriculum areas such as map skills, art, language arts, science, social studies, mathematics, and physical education and recreation.

217. Murray State University - Teachers' Workshop in Environmental Education (Youth Station, Land Between the Lakes, August 5-10, 1973). U.S. Educational Resources Information Center, ERIC Document ED 100 677, August, 1973.

Lesson plans for elementary and junior high grades, developed by teachers in an environmental education workshop covering curriculum areas such as science, language arts, mathematics, social studies, art, recreation, and health.

218. Nutrition and the Growing Population. Environmental Education Curriculum. Revised. U.S. Educational Resources Information Center, ERIC Document ED 097 216, November, 1973.

This unit attempts to respond to the increasing problem of malnutrition in the U.S. seemingly related to rising market prices, low quality foods attracting the consumer dollar and the shrinking number of students studying nutrition in out schools.

219. Paper. Environmental Ecological Education Project. Revised. U.S. Educational Resources Information Center, ERIC Document ED 097 220, June, 1972.

This unit is designed to help the intermediate elementary school student become aware of the history of paper, the papermaking process, the variety of uses and kinds of paper, the economic aspects of the papermaking industry, and the importance of recycling.

220. Planning for the Future on Spaceship Earth. Environmental Ecological Education Project. Revised. U.S. Educational Resources Information Center, ERIC Document ED 097 219, June, 1972.

Views the earth as an ecosystem by looking at the past and present human events that have influenced the quality of the environment and attempts to provide students with an awareness of the knowledge necessary for the future.

221. Plants. Environmental Education Curriculum. U.S. Educational Resources Information Center, ERIC Document ED 097 213, May, 1974.

This unit designed for intermediate level elementary students reviews basic plant structure, roles of plants in nature's systems, plant adaptations, major plant biomes, and examines ways man uses plants.

222. Schaljo, Roger. An Environmental Education Activities, Booklet 3-Mathematics Activities. U.S. Educational Resources Information Center ERIC Document ED 165 974, 1977.

Fourteen environment-related mathematics activities included help the student gain experience to help him with the practical application of abstract concepts by studying outdoors. Special emphasis is given to the experimental study of metrics and the magnetic compass, with an overall focus on the use of mathematics in real life situations.

223. Sexton, Alan D. Ed. A Curriculum Guide to Selected Environmental Topics for Use With Elementary and Junior High School Students. U.S. Educational Resources Information Center, ERIC Document ED 157 683, 1974.

Learning activities covering topics such as water, esthetics, air, soil and sediment, solid waste, energy, noise, population, and transportation. Interdisciplinary in approach with activities including pond study, poetry writing and art work.

224. Student Action for the Valley Environment (SAVE). U.S. Educational Resources Information Center, ERIC Document ED 081 601, 1973.

A mulit-disciplinary approach to environmental studies for secondary students, combining the areas of earth science, social science, and health education.

225. Suggested Activities for Environmental Edcuation in the Elementary School. U.S. Educational Resources Information Center, ERIC Document ED 144 786, 1977.

This publication is designed as a model to assist elementary teachers in developing environmental education activities in all subject areas.

226. Suggested Activities for Environmental Education in the Secondary School. U.S. Educational Resources Information Center, ERIC Document ED 144 787, 1977.

This publication is designed as a model to assist middle school and high school teachers in developing environmental education activities in all subject areas.

227. Suggested Activities Using the School and Its Surroundings as a Resource for Environmental Education. U.S. Educational Resources Information Center, ERIC Document ED 106 054, 1972.

A collection of environmental education activities focusing on the school and its surroundings as an environment that contains elements that are common to the structure of the whole man-made environment.

228. Tire Production and Pollution Control. Environmental Education Curriculum, Revised. U.S. Educational Resources Information Center, ERIC Document ED 099 208, December, 1973.

This unit was developed to introduce secondary students to the many facets of a typical large manufacturing plant-the Topeka Goodyear Tire and Rubber Company - in an effort to increase awareness of sound environmental practices in industry.

229. Total Environmental Education. U.S. Educational Resources Information Center ERIC Document ED 093 621, 1973.

An interdisciplinary design for a K-12 environmental program developed by the Division of Curriculum of the Indiana system of public education. It is desigend to assist administrators and their teaching staffs in developing activities to focus on real life experiences in the local community.

230. Total Environment Education: An Open Design to Real Life Learning Experiences. U.S. Educational Reources Information Center, ERIC Document ED 071 868, 1972.

Six global objectives--energy, earth resources, waste disposal, population, interdependence, and quality of life--are used as a framework in preparing an open design for environmental education, which emphasizes behavorial change in the affective domain.

231. Tulloch, Rodney, and Bruce Carpenter. Exploring Careers in Natural Resources and Environment: A Guide for Teachers. U.S. Educational Resources Information Center, ERIC Document ED 098 420, July, 1974.

One of eleven guides intended for use in junior high school level of career exploration. Jobs in the natural resources and environmental occupations cluster also include suggestions for possible classroom experiences, references and evaluations.

232. Vandalism. Environmental Ecological Education Project. U.S. Educational Resources Information Center, ERIC Document ED 097 218, 1974.

Unit designed to provide junior high school students with an understanding of the problem of vandalism in an effort to instill positive attitudes toward their environment and the impact they can have on their environment.

233. Water Pollution. Environmental Education Curriculum. Revised. U.S. Educational Resources Information Center, ERIC Document ED 097 217, July, 1973.

Unit designed for use with the educable mentally retarded to present information on the importance of clean water, sources of water pollution, effects of water pollution, and solution to water pollution.

234. Whitney, Helen. Comp. 101 Environmental Education Activities. Booklet 1 Art and Music Activities. U.S. Educational Resources Information Center, ERIC Document ED 165 972, 1975.

Presented are eleven environmentally-based art and music activities for elementary and intermediate grades containing, objectives, preparation, materials, directions, student evaluation, and appropriate variations,

235. _____. 101 Environmental Education Activities. Booklet 2 Language Art Activities. U.S. Educational Resources Information Center, ERIC Document ED 165 973, 1975.

Twenty language arts activities for elementary and intermediate students containing learning objectives, directions and suggested evaluation standards.

236. _____. 101 Environmental Education Activities. Booklet 4 Science Activities. U.S. Educational Resources Information Center, ERIC Document ED 165 975, 1975.

Thirty-nine environmentally-based science activities directed at students in primary, intermediate, and junior high classes. Each activity contains grade level, objectives, procedures, materials, evaluation criteria, and follow-up activities.

237. _____. 101 Environmental Education Activities. Booklet 5 Science and Social Studies(Interdisciplinary) Activities. U.S. Educational Resources Information Center, ERIC Document ED 165 976, 1975.

Nine science and social studies activities and five interdisciplinary activities are presented dealing primarily with the forest. Designed for junior high and intermediate grade levels.

238. _____. 101 Environmental Education Activities. Booklet 6. Social Studies Activities. U.S. Educational Resources Information Center. ERIC Document ED 165 977, 1975.

Twelve social studies activities are presented based on five field trips that are significant to the studies. Activities contain objectives activity descriptions, evaluations and grade levels.

239. Winter Environment. Environmental Education Curriculum, The. U.S. Educational Resources Information Center, ERIC Document ED 101 939, January, 1973.

A unit designed for special education students to help provide them with an appreciation and understanding of the winter season, and to understand how plants and wildlife are affected by the season.

INDEX

GRADE LEVELS:

K-3 1, 2, 3, 6, 32, 35, 37, 38, 40, 62, 66, 69, 70, 83, 84, 90, 94, 103, 119, 125, 126, 133, 138, 140, 141, 148, 150, 151, 166, 169, 171, 177, 178, 181, 187, 188, 189, 190, 193, 201, 205, 208, 209, 210, 217, 223, 225, 229, 234, 235, 236.

4-6 1, 2, 3, 6, 7, 15, 16, 17, 33, 35, 37, 38, 40, 41, 43, 44, 45, 46, 47, 48, 62, 66, 71, 72, 88, 90, 94, 95, 96, 98, 100, 101, 104, 105, 109, 110, 111, 112, 114, 115, 120, 122, 125, 126, 127, 128, 129, 130, 131, 138, 139, 141, 142, 145, 148, 150, 158, 160, 163, 166, 172, 173, 178, 179, 181, 187, 188, 189, 190, 193, 195, 196, 197, 204, 205, 211, 212, 213, 217, 219, 221, 223, 225, 229, 234, 235, 236, 237.

7-above 2, 3, 6, 7, 8, 15, 16, 17, 33, 34, 40, 41, 43, 44, 45, 46, 47, 48, 54, 62, 67, 68, 74, 77, 78, 79, 81, 82, 92, 93, 94, 95, 96, 97, 98, 99, 101, 102, 108, 109, 112, 113, 120, 123, 134, 135, 136, 137, 145, 148, 153, 155, 159, 161, 162, 163, 164, 165, 179, 180, 181, 183, 186, 187, 188, 189, 190, 191, 193, 198, 199, 200, 202, 205, 217, 223, 224, 226, 228, 229, 232, 236, 237.

GENERAL CURRICULUM:

1, 2, 5, 6, 16, 20, 38, 42, 44, 47, 50, 51, 53, 57, 60, 62, 63, 66, 67, 86, 89, 90, 91, 93, 95, 98, 106, 107, 108, 112, 114, 116, 117, 118, 123, 124, 126, 134, 140, 143, 144, 145, 147, 149, 150, 152, 154, 156, 157, 158, 165, 169, 170, 174, 175, 176, 179, 181, 182, 184, 185, 188, 190, 194, 195, 196, 197, 199, 200, 206, 218, 220, 222, 225, 226, 227, 230, 238, 239.

TEACHER INFORMATION AND MATERIALS:

3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 36, 37, 39, 42, 43, 45, 46, 47, 48, 49, 50, 51, 52, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 68, 71, 72, 75, 76, 78, 79, 80, 81, 83, 84, 86, 89, 91, 97, 102, 106, 107, 109, 114, 121, 122, 132, 134, 135, 136, 143, 145, 149, 151, 152, 153, 154, 155, 156, 164, 170, 176, 180, 184, 185, 191, 195, 196, 197, 199, 203, 205, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 229, 231.

SUBJECT AREAS:

Art 94, 148, 181, 214, 215, 216, 223, 234.

Health 40, 94, 181, 214, 218, 224.

Industrial Arts 16, 17, 64, 85, 94, 142, 204, 219, 228.

Language Arts 16, 17, 35, 41, 80, 94, 97, 102, 113, 114, 148, 151, 181, 206, 214, 215, 216, 223, 235.

Mathematics 35, 77, 79, 94, 101, 109, 148, 181, 201, 214, 215, 216, 222.

Music 234.

Physical Education 40, 214, 215, 216.

Science 7, 8,9, 10, 11, 12, 16, 17, 40, 43, 46, 55, 56, 65, 74, 76, 81, 87, 88, 92, 93, 94, 96, 99, 100, 104, 105, 110, 111, 115, 124, 125, 127, 128, 129, 130, 131, 133, 134, 141, 144, 145, 146, 147, 159, 160, 161, 163, 166, 167, 170, 171, 172, 177, 178, 181, 183, 186, 187, 188, 189, 190, 191, 193, 194, 198, 202, 203, 204, 206, 208, 209, 210, 211, 212, 213, 214, 215, 216, 219, 220, 221, 223, 224, 227, 228, 230, 231, 233, 236, 237.

Social Studies 7, 17, 43, 45, 46, 65, 69, 70, 75, 78, 81, 82, 87, 88, 94, 96, 103, 104, 105, 109, 116, 117, 118, 119, 132, 133, 136, 137, 138, 139, 144, 145, 146, 147, 148, 160, 162, 163, 167, 170, 172, 173, 177, 178, 180, 181, 183, 186, 187, 188, 190, 201, 202, 203, 214, 215, 216, 220, 224, 230, 232, 237, 238.

Special Education 167, 133, 239.

SECTION III

RESOURCES FOR FREE AND INEXPENSIVE ENERGY/ENVIRONMENTAL MATERIALS

During the past decade, an abundance of information has become available on the subject of energy conservation and environmental wareness. Many of the materials are free or inexpensive and come from government agencies, private corporations, and special interest groups. In this section are listed some of the materials which can be requested from various organizations. This list of resources is not intended to be exhaustive but to provide the teacher with a starting point for finding ideas for classroom activities, lessons, and also general information for broadening personal knowledge of energy and environmental topics.

The resources are listed in alphabetical order by company (or agency) name and adress, and are numbered consecutively. If more than one resource is available from one company, they are lettered and listed separately under the company address. The title of the reference is underlined and a publication date, when known, is in parentheses. Following this is an annotated bibliography giving a brief description of what the resource is about. The approximate grade level the resource is suitable for is in parentheses beneath the description. This is an approximate grade level and may be adapted for use in grades above and below the stated level.

Many resources were included in this section for use in broadening the teacher's personal knowledge of energy and environmental problems. When this is the case, "Teacher Information" is stated in parentheses in place of the grade level.

Immediately following the annotated bibliographies is the Selected References Listed by Subject (page 247). This is a cross-reference index of references on energy and the environment which the teacher can use in locating material on a specific subject in this section. The code used for listing

each resource in this section corresponds with the annotated bibliography of the same code. (for example: 11-A listed under Nuclear Energy corresponds to 11-A How Nuclear Plants Work. 11-A is a pamphlet which can be obtained from the Atomic Industrial Forum, Inc. - resource #11.)

Also included at the end of this section is a selection of Multidisciplinary References (page 250). The resources referred to here are materials on energy and the environment which can be incorporated into the existing curriculum ouside the field of science. These resources include lessons and activities which can be used in conjunction with classes in mathematics, art, social studies, etc. The references are listed by the number/letter code.

1. Air Pollution Control Association
P. O. Box 2861
Pittsburg, PA 15230

1-A A Dictionary of Air Pollution Terms

Leaflet of alphabetically arranged terms associated with air pollution.

(Grades 5 and above)

2. Alliance to Save Energy
1925 K Street, NW
Suite 507
Washington, DC 20006

2-A The Energy Puzzle - How You Fit In

Magazine on the energy problems of today and where our energy sources are for the future.

(Teacher Information)

3. The Aluminum Association
750 Third Avenue
New York, NY 10017

3-A Challenge and Change - A Story of Science and Technology (1979)

Kit includes color filmstrip, cassette tape, teacher's guide for school research projects, two posters on how aluminum is made, kit entitled "Man the Problem Solver," booklet entitled "Uses of Aluminum," and teacher's resource guide for additional free materials on aluminum.

(Grades 6 and above)

3-B Energy for the Future

Color filmstrip, 33 1/3RPM record with teacher's guide tells the energy story. Takes a close look at solar energy and the part aluminum plays as solar collectors, and aluminum's future in the auto industry. Also contains teacher's resource guide for additional free materials on aluminum.

(Grades 6 and above)

3-C Recycling, An Ecology Study (1978)

A color filmstrip and 33 1/3 RPM record with teacher's guide and poster. Tells how man is conserving natural resources by recycling. Also includes a teacher's resource guide for additional free teaching aids.

(Grades 4 and above)

4. American Gas Association
8501 East Pleasant Valley Road
Cleveland, OH 44131

4-A Natural Gas Serves Our Community (1976)

Booklet with cardboard cutouts which show how natural gas is brought to your community.

(Grades 4 - 6)

4-B The Story of Natural Gas Energy

Booklet explains what natural gas is, how it is formed, where it is produced today, how it is brought from the wells to homes and factories, and the work it performs for us.

(Grades 4 and above)

5. American Gas Association
Educational Services
1515 Wilson Boulevard
Arlington, VA 22209

5-A America's Changing Energy Story

A 7 1/2 minute, 48 frame filmstrip with cassette, tracing energy use patterns in the United States from the mid 1800's to the present.

(Grades 5 and above)

5-B Fuel Cells

A 32 frame, 35 mm filmstrip which explains research in fuel cells and its importance in the quest to efficiently change fuel directly to energy.

(Grades 6 and above)

5-C The History of Natural Gas (1976)

Comic book on natural gas.

(Grades 4 - 6)

5-D Scientists Work Together

A 44-frame filmstrip presenting how a scientist works to find a solution to a problem. The natural gas fuel cell is featured.

(Grades 6 and above)

5-E Science Principals and Gas Appliances with Experiments (1970)

Book all about gas appliances with diagrams and experiments.

(Grades 5 and above)

5. American Gas Association (Cont'd)

5-F What is a Gas? (1972)

Book of a series of laboratory activities which use materials found commonly in the home.

(Grades 4 and above)

6. American Lung Association
1740 Broadway
New York, NY 10019

6-A Air Pollution Explained: Pollution and Your Health (1973)

Pamphlet discusses the health hazards of air pollution.

(Grades 4 - 6)

6-B As You Live ... You Breathe (1979)

Pamphlet on how we breathe and how outside influences such as air temperature, moisture, smoking and air pollution affect our breathing.

(Grades 4 - 6)

6-C Breathing ... What You Need to Know (1977)

Booklet on the breathing process in depth, diseases of the breathing system and health hazards such as cigarette smoking and air pollution.

(Grades 5 and above)

6-D The Respiratory System (1976)

Wall chart showing the breathing apparatus.

(Grades 5 and above)

7. American Paper Institute, Inc.
Paper Recycling Committee
260 Madison Avenue
New York, NY 10016

7-A How to Recycle Waste Paper (1979)

Booklet describes how to establish collection programs for old newspapers, used corrugated boxes, and high grade office papers for recycling.

(Grades 4 and above)

8. American Petroleum Institute
2101 L Street, NW
Washington, DC 20037

8-A Facts About Oil

Booklet with separate lesson sheet on all facets of oil production and use.

(Grades 5 - 6)

9. AMOCO
Program Section - MC 3705
Public & Government Affairs
P. O. Box 5910-A
Chicago, IL 60680

9-A Petroleum Development Offshore

Pamphlet tells the story of exploration for petroleum at sea.

(Teacher Information)

9-B Petroleum Exploration In Brief

Pamphlet tells where petroleum is found and what conditions are necessary for its formation.

(Teacher Information)

9-C Petroleum Production In Brief

Pamphlet tells what is involved in drilling for petroleum.

(Teacher Information)

9-D Petroleum Refining In Brief

Pamphlet tells where petroleum is found and what conditions are necessary for its formation.

(Teacher Information)

9-E That Amazing Maze - A Refinery

Pamphlet outlines the process of turning crude oil into many useful products.

(Teacher Information)

10. AMOCO Teaching Aids
P. O. Box 1400 K
Dayton, OH 45414

10. AMOCO Teaching Aids (Cont'd)

10-A Catalysts & Crude - The Story of Petroleum Refining

Booklet on the aspects of petroleum refining and the products made from petroleum.

(Teacher Information)

10-B The Energy Crisis - What You Can Do About It

Activity file with five duplicating spirit masters and teacher instructions focusing on many aspects of energy.

(Grade 6 and above)

10-C It's A Great System (Pass It On)

Pamphlet reviews the American incentive market system and how it works.

(Teacher Information)

10-D Oil in Depth: The Story of Petroleum Exploration and Production

Booklet of information on what petroleum is, how it is removed from the ground, and how it is used.

(Teacher Information)

11. Atomic Industrial Forum, Inc.
Public Affairs and Information Program
7101 Wisconsin Avenue
Washington, DC 20014

11-A How Nuclear Plants Work (1976)

Pamphlet on the nature of nuclear power, the types of commercial reactors and how this energy form is harnessed.

(Teacher Information)

12. Battelle Center for Improved Education
505 King Avenue
Columbus, OH 43201

12-A A Teacher's Introduction to Energy and Energy Conservation (1975)

Book gives teacher background information and general suggestions for teaching units and correlated learning activities.

(Grades 4 and above)

13. Breeder Reactor Corporation
P. O. Box U
Oak Ridge, TN 37830

The following pamphlets are part of a series of answers to the most frequently asked questions about breeder reactors.

13-A Are Breeders Safe and Good for the Environment? (1978)

13-B Are Russia and France Ahead in Developing Breeders? (1977)

13-C Do We Know Enough About Breeders? (1977)

13-D Does My Job Depend on the Breeder? (1977)

13-E Does Nuclear Power Mean Proliferation? (1977)

13-F Is Radioactive Waste from Nuclear Power Plants a Problem? (1978)

(Teacher Information)

14. Chemical Manufacturers Association
1825 Connecticut Avenue, NW
Washington, DC 20009

14-A Chemecology

Periodical promoting a clean environment.

(Teacher Information)

15. Chevron Chemical Company
Public Affairs Department
P. O. Box 3744
San Francisco, CA 94119

15-A A Child's Garden (1978)

Fifty-four page guide of suggested classroom and outdoor activities on planting and growing. (50¢)

(Grades 1 - 6)

15-B Growing Ideas Kit (1977)

Kit contains eleven full-color cards which show how plants grow and how the weather changes. (50¢)

(Grades 1 - 4)

15-C Trees for a More Livable Environment

Forty-page guide to selected trees for special planting situations.

(Grades 4 - 6)

16. Ciba-Geigy Corporation
Agricultural Division
Greensboro, NC 27409

16-A Agriculture and the Environment (1978)

Booklet on the agricultural industry and its effects on the environment.

(Teacher Information)

17. Dow Chemical USA
Health and Environmental Sciences
Midland, MI 48640

17-A Our Methodology for Testing New Compounds

Pamphlet outlines the procedures Dow scientists go through in testing new chemical compounds for harmful toxic properties.

(Teacher Information)

17-B Silent Autumn (1977)

Book of short stories on our changing environment and life styles.

(Teacher Information)

17-C Who Protects Our Health and Environment? (1980)

Booklet outlines the work carried on in the Dow Toxicology Research Laboratory to protect the environment from possible harmful substances found in chemicals.

(Teacher Information)

18. Thomas A. Edison Foundation
Cambridge Office Plaza, Suite 143
18280 West Ten Mile Road
Southfield, MI 48075 Price: 50¢ each or 3/$1.00

18-A Alternative Energy Sources: Experiments You Can Do (1978)

Booklet contains general information and experiments on energy conservation and utilization.

(Grade 6 and above)

18-B Energy Conservation: Experiments You Can Do (1978)

Booklet contains energy information as well as simple experiments on energy waste and solar energy.

(Grades 4 and above)

18. Thomas A. Edison (Cont'd)

18-C Environmental Experiments (1973)

Booklet contains facts on pollution and the environment with related experiments for the classroom.

(Grades 4 and above)

18-D Nuclear Experiments You Can Do (1979)

Booklet contains general information on nuclear energy along with related experiments.

(Grades 6 and above)

18-E Selected Experiments and Projects (1976)

Booklet contains biographical data on Thomas A. Edison and some of the projects Edison worked on. Experiments for the classroom are suggested with instructions provided.

(Grades 6 and above)

18-F Useful Science Projects (1979)

Booklet contains projects on electricity for the classroom.

(Grades 6 and above)

19. Energy Management Center
P. O. Box 190
Port Richey, FL 33568

19-A Energy Education for the Elementary Classroom (1978)

Publication of worksheets and activities related to energy conservation.

(Grades 4 - 6)

19-B Let's Learn About Energy - Module A

Activities and worksheets introducing the concept of energy.

(Grades 4 - 6)

19-C Man and Energy - Module C

Activities and worksheets on energy production and use.

(Grades 4 - 6)

19-D Nature's Energy - Module B

Activities and worksheets on the energy cycle and fossil fuels.

(Grades 4 - 6)

19. Energy Management Center (Cont'd)

19-E Teacher Method Book: Elementary Energy Education

Teacher manual designed to aid in presenting the energy program to the class. Offers background information relating to the energy topics covered in the student modules A, B, and C.

(Grades 4 - 6)

20. EXXON
Public Affairs Department
P. O. Box 2180
Houston, Texas 77001

20-A Energy Outlook - 1977-1990 (1977)

Booklet discusses U.S. energy supply and demand.

(Teacher Information)

20-B Mickey Mouse and Goofy Explore Energy (1976)

Comic book about the adventures of Mickey Mouse and Goofy as they learn about energy.

(Grades 3 - 6)

20-C Tommy's Remarkable Journey

Large wall poster describing the steps involved in producing gasoline.

(Grades 4 - 6)

21. Federal Energy Administration
Office of Communications and Public Affairs
Washington, DC 20461

21-A Energy Activities with Energy Ant (1976)

Booklet of activities including puzzles, pages for coloring, and games.

(Grades 2 - 5)

22. The Garden Club of America
598 Madison Avenue
New York, NY 10022

22-A The World Around You: Environmental Education Packet (1980)

Packet containing general information on environmental subjects and related activities for classroom and individual use.

(Grades 4 - 6)

23. GTE Sylvania, Inc.
Public Affairs Department
S. Lighting Center
Danvers, MA 01923

23-A Light and Man - The Evolution of Lighting

Wall poster depicting the history of lighting from the early street light through lighting of today.

(Grade 4 and above)

23-B Light and Man - Radiant Energy

Pamphlet outling research on radiant energy being conducted in the areas of infrared, ultraviolet, gro-lux and laser.

(Grades 6 and above)

24. International Business Machines Corp.
Armonk, NY 10504

24-A Anybody Out There Think the Energy Crisis is Over? (1976)

Reprint from the IBM Employee Magazine, "Think" (Oct/Nov 1976 issue), on energy conservation in business and industry.

(Teacher Information)

24-B Save Your Energy and Your Money

Booklet of ideas on how to conserve energy in the home.

(Teacher Information)

25. S. C. Johnson & Son, Inc.
1525 Howe Street
Racine, WI 53404

25-A The Living Planet: Student Environmental Education Kit

Kit introduces the subject of ecology and environmental awareness to students. Includes teaching guide, student booklets, poster, and duplicating masters. Film entitled "The Living Planet" may be borrowed to accompany lesson.

(Grades 5 - 6)

26. Keep America Beautiful, Inc.
99 Park Avenue
New York, NY 10016

26-A Community Clean-up Campaign Check List

Sheet suggests community activities for a clean-up campaign.

26. Keep America Beautiful, Inc. (Cont'd)

26-B Leaf Composting Guide

One sheet guide for composting, including the collection and storage of leaves and proper treatment of the compost pile.

(Teacher Information)

26-C Organizing an Anti-Litter Project with Steel Drums and Pails

Suggestions on decorating and distributing the proper steel drums and pails throughout your community to aid in litter-control.

(Grades 6 and above)

26-D Point Poster

An 11" x 28" full color poster with the slogan "A Five-Point Program to Stop Pollution" and the Keep America Beautiful theme "People Start Pollution. People Can Stop It." (50¢)

26-E Pollution Pointers for Elementary Students

Environmental improvement activities for the elementary grades.

(All elementary grades)

26-F Your Community is an Environmental Resource

A guide to aid teachers and students in treating their community as a living laboratory in which to implement conservation principals. (50¢)

(All elementary grades)

27. National Aeronautics and Space Administration
Washington, DC 20546

27-A Improving Our Environment (1973)

Pamphlet discusses NASA's environmental effort and the technology they are using.

(Teacher Information)

28. National Coal Association
Coal Building
1130 17th Street NW
Washington, DC 20036

28-A Coal (1979)

Reprint from the World Book Encyclopedia explains what coal is, where it was formed, where it is found, how it is mined and what it's uses are.

(Grades 4-6)

28. National Coal Association (Cont'd)

29-B The Power of Coal

Teacher's guide and student tear-out quiz sheets on history, mining, marketing and utilization of coal.

(Grades 4 - 6)

29. National Science Teachers Association
1742 Connecticut Avenue, NW
Washington, DC 20009

29-A Energy-Environment Source Book (1975)

Teacher source book for incorporating the subject of energy into the classroom.

(Grade 6 and above)

29-B Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy: Transportation and the City (1976)

This booklet consists of learning activities centered around the automobile, designed to be incorporated into the U.S. history and civic courses. (Teacher's Manual)

(Grades 4 and above)

30. North Carolina Department of Public Instruction
Division of Science Education
Raleigh, NC 27611

30-A Crisis Game (1977)

Energy game with board and directions for 2 to 4 players.

(Grades 3 - 6)

The following manuals (30-B, 30-C, and 30-D) contain activities on energy designed to integrate energy conservation education into the existing classroom.

30-B Energy Activities: Making the Most of What We Have - Grades K-3 (1979)

30-C Energy Activities: Making the Most of What We Have - Grades 4-6 (1979)

30-D Energy Activities: Making the Most of What We Have - Grades 7-12 (1979)

30-E Energy Conservation: A Source Book (1975)

Suggestions for energy activities in the classroom and school.

(Grades 4 - 6)

30. North Carolina Department of Public Instruction (Cont'd)

30-F Energy Awareness Card Game

Cards to cut out with game instructions. Game is for 2 to 3 players.

(Grades 3 - 5)

30-G Environmental Education Instructional Unit: Natural Resources (1973)

A unit of lessons and activities on conserving our natural resources.

(Grades 4 and above)

30-H Environmental Education Instructional Unit: Pollution (1973)

A unit of lessons and activities on various types of pollution problems.

(Grades 4 and above)

30-I Environmental Education Instructional Unit: Population (1973)

A unit of lessons and activities on problems associated with large populations.

(Grades 4 and above)

30-J Fox City: Environmental Education Game

Role-playing game involving decision making on energy conservation issues in the town of "Fox City."

(Grades 4 and above)

31. Oak Ridge Associated Universities
American Museum of Atomic Energy
P. O. Box 117
Oak Ridge, TN 37830

31-A Energy and the Environment: Citizen's Workshop Handbook (1975)

Discusses energy needs and environmental problems. Also refers to various sources of energy and our energy future.

(Teacher Information)

31-B The Graphite Reactor - A National Historic Landmark (1975)

Pamphlet gives a brief history of the graphite reactor in Oak Ridge, Tennessee.

(Teacher Information)

31. Oak Ridge Associated Universities (Cont'd)

31-C Group Activities: Energy

Pamphlet of information on tours through the American Museum of Atomic Energy, as well as class activities and demonstrations available at the museum to students.

(Teacher Information)

31-D Oak Ridge History: Energy

Pamphlet on the history of Oak Ridge and the energy research and development project.

(Teacher Information)

31-E Science Activities in Energy

A series of experiments ranging from simple to complex which illustrate principals and problems related to energy and to the development, use and conservation of the different forms.

(Teacher Information)

31-F Spend a Day with the American Museum of Atomic Energy

Gives information on what is available for class field trips to the museum, and how teachers can make arrangements for trips.

(Teacher Information)

31-G The Subject is Energy - Secondary Level Activities

Pamphlet of suggestions for energy activities Jr. High and High School students can do before their visit to the American Museum of Atomic Energy. (Possibly suitable for 6th grade.)

(Teacher Information)

32. Oregon State Department of Education
942 Lancaster Drive, NE
Salem, OR 97310

32-A Energy Crisis Teaching Resources (1974)

Teaching ideas and general information about the energy crisis.

(Grades 1 - 12)

32-B A Handbook of Environmental Encounters (1973)

Resource guide for teachers for use in the development of attitudes for a quality environment.

(Grades 4 and above)

33. Phi Delta Kappa
Box 789
8th and Union
Bloomington, IN 47402

33-A Energy Education: Goals and Practices (1980)

Booklet on energy conservation and education, and introducing the subject into the classroom.

(Grades 4 - 6)

34. Reynolds Aluminum Recycling Company
Richmond, VA 23261

34-A Michael Recycle Comic Book (1980)

Comic book on children learning all about recycling with Michael Recycle.

(Grades 2 - 4)

35. Sears, Roebuck & Company
Consumer Information Services
Department 703 - Public Relations
Sears Tower
Chicago, IL 60684

35-A The Energy Crisis in the Classroom (1974)

Reprint from the Kaleidoscope. A unit on energy conservation with activities and lessons.

(Grades 6 and above)

36. Shell Oil Company
One Shell Plaza
Houston, TX 77002

36-A Let's Collect Rocks and Shells (1979)

Booklet explains all about rocks and shells and how to start collecting them.

(Grades 3 - 6)

36-B Shell's Wonderful World of Oil (1975)

Pamphlet gives facts about oil, its origin, drilling process, production, transportation, manufacturing, distribution and research.

(Teacher Information)

36. Shell Oil Company (Cont'd)

36-C The Story of Petroleum (1978)

Booklet traces the development of oil and gas, and focuses on the people who make up the multifaceted oil industry.

(Teacher Information)

37. The Soap and Detergent Association
475 Park Avenue, South
New York, NY 10016

37-A Soaps, Detergents and the Environment

Filmstrip with cassette introducing basic facts about soaps and detergents, and environmental concerns.

(Grades 6 and above)

38. Standard Oil Company
Teaching Aids
P. O. Box 5910-A
Chicago, IL 60680

38-A Living With Energy

Activity guide on conservation of energy, effective ways to use energy, and the search for energy solutions. Contains 5 spirit duplicating masters.

(Grades 5 - 6)

39. Tennessee State Department of Education
112 Cordell Hull Building
Nashville, TN 37219

39-A Activities and Resources for Teaching Environmental Education, K-12 (1978)

Book illustrates sample activities for teaching environmental education and serves as a resource guide for obtaining and developing additional activities.

(Teacher Manual, Grades K-12)

39-B Environmental Education in Tennessee: A State Plan for Cooperation by Joe Minor

Outlines services and resources available to the public schools, and suggests ways in which existing organizations may contribute toward improving environmental education programs.

(Teacher Information)

40. Tennessee Valley Authority
Environmental Education Specialist
Environmental/Energy Education Program
Division of Land and Forest Resources
Norris, Tennessee 37828

40-A Electric Savings (1979)

A pamphlet of practical ways to help lower your electric bill.

(Teacher Information)

40-B Energy Activities: A Station Approach

Folder of activities to develop awareness of present energy problems and energy conservation ethics.

Also available from the following address:

Assistant Chief of Recreation
Interpretation and Environmental Educ.
Land Between the Lakes
Golden Pond, KY 42231

(Grades 4 - 6)

40-C Mini-Poster Series - Earth Day '80

Posters with activities listed on the back about subjects such as recycling, water, wildlife, energy, solar energy, etc.

(Grades K and above)

41. Texas Education Agency
Division of Curriculum Development
201 E. Eleventh Street
Austin, Texas 78701

41-A Outdoor Education - A Guide to Site Planning and Implementation of Programs (1976)

Teacher guide for developing activities for education in the out of doors.

(Grades 3 - 9)

42. U.S. Department of Agriculture
Forest Service
Washington, DC 20250

42-A Investigating Your Environment: Teaching Materials for Environmental Education (1978)

Lesson plans and activities which involve the student in collecting, recording and interpreting data on their surroundings.

(Grades 4 and above)

43. U.S. Department of Agriculture
Soil Conservation Service
Information Division
Washington, DC 20250

43-A Environmental Education In Action I (1973), and Environmental Education in Action II (1975)

Reprints from "Soil Conservation" magazine of articles on what is taking place in different parts of the country with environmental education.

(Teacher Information)

43-B Outdoor Classrooms on School Sites (1972)

Booklet for use in developing and using outdoor classrooms on school sites of all types and sizes.

(Grades 1 - 6)

44. U.S. Department of Energy
Office of Consumer Affairs
Washington, DC 20585

44-A Energy Activities with Energy Ant

A workbook of activities to tell children about energy and how to use it wisely. Includes pictures to color, games, riddles, cut-outs, crossword puzzles and more.

(Grades 1 - 4)

44-B How We Make Energy Work: Grades 4, 5, and 6 Science (1980)

Teacher manual and activities divided into 4 units of 2 to 4 lessons each on the basic concepts of energy.

(Grades 4 - 6)

44-C Put the Sun to Work Today (1978)

Booklet explains the different solar heating systems and how solar energy can be used to produce electricity and fuels.

(Teacher Information)

44-D through I Science Activites in Energy*

Series of 6 packets of simple experiments which illustrate principals and problems related to various forms of energy. Each packet listed below is on one specific aspect of energy.

44-D Chemical Energy	44-G Solar Energy
44-E Conservation	44-H Solar Energy II
44-F Electrical Energy	44-I Wind Energy

(Grades 3 and above)

44. U.S. Department of Energy (Cont'd)

44-J Tips for Energy Savers (1978)

Booklet of ideas and suggestions on how to save energy and money at home, on the road, and in the marketplace.

(Teacher Information)

44-K through N Your Energy World (1978)

Following are four kits for classroom use on energy conservation.

44-K Your Energy World: Energy Overview - Unit One

Kit contains six activity masters and teacher guide. It is an overview of energy definitions, energy resources, and possible energy problems.

(Grades 4 - 6)

44-L Your Energy World: Transportation, The Energy Eater - Unit Two

Kit contains four activity masters and teacher guide. This unit assists in student awareness of the portion of the total energy consumption by transportation.

(Grades 4 - 6)

44-M Your Energy World: Energy Use in Homes and Stores - Unit Three

Kit contains four activity masters and teacher guide. This unit consists of energy-saving tips that children can put into practice and can share with parents.

(Grades 4 - 6)

44-N Your Energy World: Schools Can Conserve Too - Unit Four

Kit contains four activity masters and teacher guide. Each activity is part of a simulation in which the students assume the roles of adults in their school system and community to put energy conservation plans into action.

(Grades 4 - 6)

45. U.S. Department of Energy
Technical Information Center
P. O. Box 62
Oak Ridge, TN 37830

45-A Atoms on the Move: Transporting Nuclear Material by Joseph Dukert (1975)

Booklet on radioactive material and what is involved in moving these materials between sites.

45. U.S. Department of Energy
Technical Information Center (Cont'd)

45-B Award Winning Energy Education Activities (1977)

Booklet describes teaching ideas and classroom activities which were the winning entires to the NSTA Teacher Participation Contest conducted in the spring of 1976.

(Teacher Information)

45-C Creating Energy Choices for the Future: A Summary of the National Plan for Energy Research, Development and Demonstration (1975)

Booklet highlights and explains the 1975 National Energy Plan.

(Teacher Information)

45-D through G Easy Energy Reader Series (1980)

Following are four books explaining energy concepts in an easy to understand format.

45-D Book I - Easy Energy Reader: What is Energy?

Book I discusses what energy is, energy sources, how energy is stored, and how it is transported. Contains glossary of terms.

(Grades 4 - 6)

45-E Book II - Easy Energy Reader: History of Energy

Book II discusses the history of energy and how it has come to play such an important role in our daily lives. Contains glossary of terms.

(Grades 4 - 6)

45-F Book III - Easy Energy Reader: What Can We Do Right Now?

Book III analyzes the causes of the nation's current energy related problems and offers possible solutions. Contains glossary of terms.

(Grades 4 - 6)

45-G Book IV - Easy Energy Reader: Energy - What About the Future?

Book IV provides an insightful look at future technology. Contains glossray of terms.

(Grades 4 - 6)

45. U.S. Department of Energy
Technical Information Center (Cont'd)

45-H The Energy Challenge

An activity master program about our energy past, present and future. Covers all energy sources.

(Grades 4 - 8)

45-I Energy Conversion, Storage and Transmission (1976)

Pamphlet explaining useful and efficient ways energy can be converted, stored and transmitted from power plants to major consumption areas.

(Teacher Information)

45-J The Energy Dome: Social Studies Packet - Grades 4, 5, 6 (1980)

Book consists of teacher and student guides - 4 units of 2 to 3 lessons in each unit on energy production and use.

(Grades 4 - 6)

45-K The Energy Future Today: Grades 7, 8, 9 Social Studies (1980)

Book consists of teacher and student guides - 4 units of 2 to 3 lessons each dealing with energy use and the prospects for the future.

(Grades 6 and above)

45-L An Energy History of the United States - Grades 8-9 (1978)

Source book for teachers with lesson plans and activities, plus student handouts on the history of our transformation from wood to coal to oil during the past two centuries.

(Grades 7 and above)

45-M Energy Storage by William W. Eaton

Pamphlet outlines some of the most promising new methods for storing energy.

(Teacher Information)

45-N Energy Technology (1976)

Pamphlet outlines some of the present known sources of energy.

(Teacher Information)

45-O Energy Trails Volume 1

A guide to energy sites, power plants, science museums, etc. in the northeastern states.

45. U.S. Department of Energy
Technical Information Center (Cont'd)

45-P Energy Transitions in U.S. History (1979)

Gives students an understanding of the influence that each source of energy has on the culture and the impact of energy change. The physical properties of wood, coal and oil are studied.

(Grades 6 and above)

45-Q Factsheet - NSTA (1977)

The following factsheets give definitions, general information, and technological and environmental pros and cons.

1. Fuels from Plants (Bioconversion)
2. Fuels from Wastes (Bioconversion)
3. Wind Power
4. Electricity from the Sun I (Solar Photovoltaic Energy)
5. Electricity from the Sun II (Solar Thermal Energy Conversion)
6. Solar Sea Power (Ocean Thermal Energy Conversion)
7. Solar Heating and Cooling
8. Geothermal Energy
9. Energy Conservation: Homes and Buildings
10. Energy Conservation: Industry
11. Energy Conservation: Transportation
12. Conventional Reactors
13. Breeder Reactors
14. Nuclear Fusion
15. New Fuels from Coal
16. Energy Storage Technology
17. Alternative Energy Sources: Environmental Impacts
18. Alternative Energy Sources: A Glossary of Terms
19. Alternative Energy Sources: A Bibliography

When ordering any of the above factsheets, please include the number immediately preceeding the title.

(Teacher Information)

45-R Geothermal Energy (1980)

Pamphlet outlines where geothermal is found in the United States, how it generates electricity, and its environmental and economic considerations.

(Teacher Information)

45-S Geothermal Energy and Our Environment

Brochure on geothermal resources and environmental issues. Opens out to display a large geothermal poster.

(Grades 5 and above)

45. U.S. Department of Energy
Technical Information Center (Cont'd)

45-T Geothermal Energy: Teacher Guide and Student Worksheets

A junior high school, two day course. First lesson is entitled Heat Within the Earth. The second lesson is Geothermal Energy, Nature's Boiler.

(Grades 7 - 9)

45-U Heated Water from Power Plants (1975)

Pamphlet discusses the problems to aquatic life when heated water is discharged in large quantities into lakes, bays and streams.

(Teacher Information)

45-V High Level Radioactive Wastes from Nuclear Power Plants (1976)

Pamphlet explains nuclear fuel reprocessing, ERDA's plan for storing waste and experience in handling radioactive waste.

(Teacher Information)

45 W through Z Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy - Teacher Manual/Student Guide

45-W Energy and Transportation - Grade 3 (1979)

Lesson plans and activities designed to develop a conscious appreciation of the variety of transportation modes and of the ways that modern transportation systems affect our world.

45-X Networks - How Energy Links People, Goods and Services - Grades 4 and 5 (1980)

This unit consists of lesson plans and activities for investigating a simple energy network and making analogies with similar mutually supporting energy networks.

45-Y Two Energy Gulfs - Grades 6 and 7 (1980)

Lesson plans and activities on energy and the people who live in two oil producing regions of the world - the Persian Gulf and the Gulf of Mexico.

45-Z Mathematics in Energy - Grades 8 and 9 (1979)

Lessons and activities to aid students in learning important math skills along with important quantitative facts on energy.

45. U.S. Department of Energy
Technical Information Center (Cont'd)

45-AA Providing for Energy Efficiency in Homes and Small Buildings (1980)

Teacher Guide, Student Workbook, and basic manual in three separate parts (five books total). The three manuals are titled as follows:

I. Understanding and Practicing Energy Conservation in Buildings
II. Determining Amount of Energy Lost or Gained in a Building
III. Determining Which Practices are Most Efficient and Installing Materials

This is a training program designed to educate students in the fundamentals of conserving energy and to provide for developing skills needed in the application of energy-saving techniques that result in energy efficient buildings.

(Grade 7 and above)

45-BB Solar Energy (1978)

Pamphlet on uses of solar heat such as for heating and cooling, and heat for industrial and agricultural use. Also discusses wind and water power.

(Teacher Information)

45-CC Solar Energy for Agriculture and Industry (1978)

Pamphlet discusses how energy from the sun can aid agriculture and industry.

(Teacher Information)

45-DD Transportation and the City: Grades 8 and 9 (1979)

Teacher manual and student guide. This unit outlines the reasons for the decline of the small towns as a result of the automobile, and the growth of suburbs and their effect on the city.

45-EE U.S. Energy Options (1976)

Pamphlet discusses what the United States can do to supply its ever-increasing demand for energy in the future, outlining near and long-term options.

(Teacher Information)

46. U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460

46-A Acid Rain: The Time to Act is Now (1930)

Comments by Douglas M. Costle in pamphlet form on what is

46. U.S. Environmental Protection Agency (Cont'd)

46-A (Cont'd)

known and suspected about the ill effects of acid rain, and how EPA is involved in the problem.

(Teacher Information)

46-B 1978 Report: Better Health and Regulatory Reform (1979)

Booklet on the part EPA is playing in solid waste disposal by factories, control of hazardous waste, prevention of the release of toxic chemicals, noise, air and water pollution, recycling, and working with other agencies.

(Teacher Information)

46-C Cleaning the Air (1979)

Booklet describing EPA's program for air pollution control.

(Teacher Information)

46-D Common Environmental Terms (1977)

Booklet composed of short definitions of common environmental terms.

(Grades 5 and above)

46-E Environmental Exchange - A Beginning: President's Environmental Merit Awards Program (1976)

Booklet summarizing a sample of various school and youth group environmental projects which were submitted to the President's Environmental Youth Awards Program.

(All grades included)

46-F EPA Journal Reprint: Earth Day '80 (4/1980)

Short articles on people involved in all aspects of protecting the environment.

(Teacher Information)

46-G EPA Journal Reprint: Energy and the Environment (4/1979)

Several articles on subjects about energy including energy resources in gas, solar, wood, etc. Includes information on TVA (Tennessee Valley Authority).

(Teacher Information)

46. U.S. Environmental Protection Agency (Cont'd)

46-H EPA Journal Reprint: The Environmentalists (10/1978)

Short essays on environmental problems by the leaders of environmental conservation groups.

(Teacher Information)

46-I EPA Journal Reprint: Environment and the Law (6/1980)

Articles on legal aspects of environmental pollution.

(Teacher Information)

46-J EPA Journal Reprint: The Federal Effort (9/1980)

Articles on the federal government's involvement in environmental efforts.

(Teacher Information)

46-K EPA Journal Reprint: Land and the Environment (7-8/1980)

Articles on soil conservation and farmland, the American Indians (the first environmentalists), energy from biomass, and EPA's soil research laboratory.

(Teacher Information)

46-L EPA Journal - Noise and the Environment (10/1979)

This issue reviews the battle against noise at home, work, and on the streets.

(Teacher Information)

46-M EPA Journal Reprint: Science and the Future (10/1980)

Short articles on such subjects as EPA's involvement in air pollution, EPA's role at Three Mile Island, EPA's environmental monitoring systems laboratory, and the Science Advisory Board.

(Teacher Information)

46-N EPA Journal Reprint: Year of the Coast (5/1980)

Articles on the development of, and environmental threats to, the U.S. coastal areas.

(Teacher Information)

46-O EPA: Protecting Our Environment (3/1977)

Booklet gives an overview of the functions of the EPA as related to cleaning up and preventing pollution.

(Teacher Information)

46. U.S. Environmental Protection Agency (Cont'd)

46-P Hazardous Waste: No Quick Winners (1980)

Pamphlet on speech made by Thomas F. Williams, Deputy Director, Office of Public Awareness, EPA, on PL 94-580 (The Resource Conservation and Recovery Act). This speech was presented at a conference on the disposal and shipping of radioactive and toxic chemical wastes.

(Teacher Information)

46-Q Is Your Drinking Water Safe? (1977)

Pamphlet discusses U.S. government programs set up to ensure safe drinking water in America.

(Teacher Information)

46-R Pollution and Your Health (1976)

Booklet focuses on air, water and noise pollution, the problems of solid wastes, pesticides, and their effects on health.

(Teacher Information)

46-S The Quality of Drinking Water (1977)

Booklet gives facts regarding public drinking water and its use, and information on federal regulations of drinking water.

(Teacher Information)

46-T Solid Waste Management: Recycling and the Consumer (1974)

Booklet details what materials are recyclable and which ones are not, and what the consumer can do.

(Teacher Information)

46-U The Toxic Substances Control Act (1977)

Booklet contains information on the Toxic Substances Control Act which authorizes EPA to obtain data on matters concerning chemical substances and mixtures and, if warranted, to regulate the manufacture, processing, distribution, and disposal of a chemical.

(Teacher Information)

46-V Women and the Environment - Women as Agents of Change (1977)

Pamphlet on the various roles women are engaged in in protecting and changing the environment.

(Teacher Information)

46. U.S. Environmental Protection Agency (Cont'd)

46-W Working Together (1979)

Pamphlet outlines how five agencies are working together to improve health and safety. Also included is a list of regional office addresses: (1) U.S. Consumer Product Safety Commission, (2) U.S. Environmental Protection Agency, (3) Food and Drug Administration, (4) USDA Food Safety and Quality Service, (5) U.S. Department of Labor, Occupational Safety and Health Administration.

(Teacher Information)

47. U.S. Department of the Interior
Washington, DC 20240

47-A A Better Place to Be: A Guide to Environmental Learning in Your Classroom (1974)

This booklet contains classroom activities and ideas on a variety of subjects dealing with the environment. ($1.25 each)

(Grades 3 - 7)

47-B Interior's Role in Energy and Resources

Pamphlet telling about the Department's role in various research and development aspects of energy.

(Teacher Information)

48. U.S. Department of the Interior
Fish and Wildlife Service
Washington, DC 20240

48-A through L We Can Help: Environmental Educational Teaching Resources (1975)

The following are folders by topics containing activities for grades 4, 5 and 6 (Level I). Also available are Level II topics for grades 7 through 12.

48-A Careers
48-B Fish Hatcheries
48-C Insects and Plants
48-D Muskrats
48-E Old Ponds and Young Ponds
48-F Plants and Places
48-G A Population of Pocket Gophers
48-H Snow Depth and Snow Melt
48-I Snow Temperature
48-J Social History Cemetary Study
48-K Water Flow and Impoundment
48-L Wildlife/Wildlands Photography

49. U.S. Department of the Interior
Bureau of Land Management
Washington, DC 20240

49-A All Around You: An Environmental Study Guide (1971)

Book of activities for the classroom and schoolyard, the town and natural areas. ($1.50 each)

(Grades 1 - 6)

50. U.S. Department of the Interior
Bureay of Mines
4800 Forbes Street
Pittsburg, PA 15213

50-A Abandoned Coal-Mined Lands

Booklet outlining the nature, extent and cost of reclamation of land abandoned after being mined for coal.

(Teacher Information)

50-B Coal Products Tree

Black and white poster (10½" by 12") showing products obtainable from coal.

(Grades 6 and above)

50-C For the People

Booklet outlining some of the research projects the Bureau of Mines is involved with.

(Teacher Information)

50-D Mineral Facts and Problems

Individual chapters available on approximately 90 minerals at a minimal cost. Write for the mail order form. Some energy or environmental related chapters are:

Aluminum 45¢
Anthracite 35¢
Bituminous Coal 40¢
Hydrogen 40¢
Iron Ore 45¢
Iron and Steel 65¢
Lead 45¢
Natural Gas 55¢
Petroleum 60¢
Shale Oil 60¢
Uranium 60¢

50-E The Petroleum Tree

Black and white poster (10½" by 12") showing products obtainable from crude oil.

50. U.S. Department of the Interior
Bureau of Mines (Cont'd)

50-F To Save the Land

Pamphlet outlining some ways the Bureau of Mines is combating environmental damage from mining operations.

(Teacher Information)

51. U.S. Department of the Interior
Bureau of Reclamation
Washington, DC 20240

51-A Conservation and Full Utilization of Water

Large fold-out wall poster depicting the various uses for, and means of transporting water.

(Grades 4 and above)

52. University of Tennessee at Knoxville
The Energy Education Program
324 Henson Hall
Knoxville, Tennessee 37916

52-A Energy Education is Basic (1980)

A manual of lessons and activities to acquaint students with various forms of energy - how they are produced, consumed and conserved. This manual may be used in conjunction with a series of television programs through WSJK-TV in Knoxville, Tennessee.

53. Virginia Division of Litter Control
Department of Conservation and Economic Development
1215 State Office Building
Richmond, VA 23219

53-A Litter Control Project Guide for Elementary School Teachers (1978)

Guidebook of home, classroom, and school-wide activities on litter control.

(Grades K - 6)

53-B through H Operation Waste Watch (Phase II) (1979)

A series of seven sequential learning units of activities which address the subjects of litter control and solid waste management. Each learning unit is designed for a specific grade level.

53. Virginia Division of Litter Control (Cont'd)

53-B through H (Cont'd) Each unit (in booklet form) is listed separately below.

- 53-B Kindergarten: Natural and Man-Made Waste
- 53-C Level 1: Waste Out of Place
- 53-D Level 2: Litter Pollution
- 53-E Level 3: Trash Trends
- 53-F Level 4: Let's Waste Less Waste
- 53-G Level 5: Trash Treasures
- 53-H Level 6: Community Solutions for Solid Waste Pollution

54. World Book Encyclopedia
Merchandise Mart Plaza
Chicago, IL 60654

54-A Earth: Our Restless Blue Planet

A fold-out learning guide on where to find information about the earth in the World Book Encyclopedia.

(Grades 4 - 6)

54-B The Energy Problem (1976)

A fold-out learning guide of where to find information on energy in the World Book Encyclopedia.

(Grades 4 - 6)

55. Xerox Corporation
Xerox Educational Publications
Education Center
Columbus, OH 43216

55-A You and Your Environment (1971)

Teacher guide to lesson plans and activities aimed at building attitudes and offering an overall picture of ecology to students. Part I includes information for basic understandings of interrelationships, diversity and adaptation of living things. Part II adds webs, cycles and chains.

(Grades 4 - 7)

SELECTED REFERENCES LISTED BY SUBJECT

ALUMINUM

(see Recycling)

CHEMICAL ENERGY

19-B, 19-E, 44-D, 51-A.
See also: Fuel Cell, Hazardous Waste Materials and Toxic Substances.

COAL

(see Fossil Fuels)

ECOLOGY AND ENVIRONMENTAL AWARENESS

14-A, 15-A, 15-B, 15-C, 16-A, 17-B, 17-C, 18-C, 22-A, 25-A, 26-B, 26-E, 26-F, 26-G, 27-A, 31-A, 32-B, 37-A, 29-A, 39-A, 39-B, 40-C, 41-A, 42-A, 43-A, 43-B, 44-K, 45-Q, 45-S, 46-D, 46-E, 46-F, 46-G, 46-H, 46-I, 46-K, 46-N, 46-O, 47-A, 48-A through L, 49-A, 50-A, 55-A.

ELECTRICITY

2-A, 10-B, 12-A, 18-B, 18-E, 18-F, 19-B, 19-C, 18-E, 20-A, 20-B, 29-A, 30-C, 30-D, 40-A, 44-A, 44-B, 44-F, 44-J, 44-K, 44-L, 44-M, 44-N, 45-D, 45-E, 45-I, 45-X, 45-AA, 52-A.

ENERGY CONSERVATION

2-A, 11-A, 17-G, 18-B, 19-A, 19-C, 19-E, 22-A, 24-B, 30-B, 30-C, 30-D, 30-E, 30-F, 30-G, 30-J, 32-A, 35-A, 38-A, 40-A, 40-B, 44-A, 44-E, 44-K, 44-N, 45-H, 45-K, 45-Q, 45-Y, 45-AA, 46-G, 46-J, 47-A, 51-A, 52-A, 53-A.

FOSSIL FUELS (General)

2-A, 5-A, 10-B, 12-A, 19-C, 19-D, 20-B, 21-A, 29-A, 30-D, 31-G, 35-A, 38-A, 39-A, 44-A, 44-B, 45-N, 45-X, 45-DD, 47-B, 50-A, 52-A.

COAL

20-A, 28-A, 28-B, 30-B, 30-C, 45-D, 45-J, 45-K, 45-P, 45-Q, 45-EE, 50-A, 50-B, 50-C.

NATURAL GAS

4-A, 4-B, 5-A, 5-B, 5-C, 5-D, 5-E, 5-F, 20-A, 36-C, 44-K, 45-E, 45-EE, 50-A.

PETROLEUM (Oil)

8-A, 9-A, 9-B, 9-C, 9-D, 9-E, 10-A, 10-D, 20-A, 20-C, 36-B, 36-C, 44-K, 45-J, 45-P, 45-Y, 45-CC, 45-EE, 50-D.

FUEL CELLS

5-B, 5-D, 10-B, 18-A.

GEOTHERMAL ENERGY

2-A, 10-B, 18-A, 20-B, 29-A, 30-C, 31-A, 35-A, 45-G, 45-H, 45-N, 45-Q, 45-R, 45-S, 45-T, 47-B, 51-A.

HAZARDOUS WASTE MATERIALS

13-B, 45-V, 46-B, 46-P.

HISTORY OF ENERGY

5-A, 5-C, 19-B, 19-D, 19-E, 20-B, 23-A, 23-B, 45-E, 45-H, 45-L, 45-P, 46-I.

HYDROELECTRIC POWER

2-A, 10-B, 12-A, 38-A, 47-B, 51-A.

INSULATION

19-C, 19-E, 35-A, 40-A, 44-M, 45-AA.

LITTER CONTROL

22-A, 26-A, 26-C, 26-F, 47-A, 53-A through H.
See also: Solid Waste.

MECHANICAL ENERGY

19-B, 19-E, 45-D.

NATURAL GAS

(See Fossil Fuels)

NUCLEAR ENERGY

10-B, 11-A, 12-A, 13-A, 13-B, 13-C, 13-D, 13-E, 13-F, 18-D, 19-B, 19-E, 20-B, 30-C, 31-A, 31-B, 31-C, 31-F, 31-G, 38-A, 44-A, 44-B, 45-A, 45-G, 45-H, 45-J, 45-K, 45-N, 45-Q, 45-V, 45-EE, 46-G, 46-M, 46-P, 52-A.

OCEAN/TIDAL ENERGY

2-A, 18-A, 31-A, 45-G, 45-Q.

PETROLEUM (Oil)

(See Fossil Fuels)

POLLUTION (General)

18-C, 19-D, 19-E, 26-D, 26-E, 30-H, 32-B, 45-R, 46-B, 46-F, 46-I, 46-O, 47-A, 49-A, 50-F.

POLLUTION (Cont'd)

AIR POLLUTION

1-A, 6-A, 6-B, 6-C, 18-C, 22-A, 27-A, 29-A, 44-K, 46-A, 46-C, 46-I, 46-M.

LAND POLLUTION

(See Litter Control and Solid Waste)

NOISE POLLUTION

26-F, 27-A, 30-H, 46-L.

WATER POLLUTION

29-A, 30-H, 30-J, 32-B, 45-U, 46-A, 46-K, 46-S, 46-Z.

POPULATION

25-A, 30-I, 30-J, 39-A, 49-A.

RECYCLING

2-A, 3-B, 3-C, 7-A, 12-A, 18-C, 22-A, 25-A, 26-F, 27-A, 30-H, 34-A, 35-A, 39-A, 40-C, 45-E, 46-B, 46-F, 46-T.

SOLAR ENERGY

2-A, 3-B, 10-B, 12-A, 18-A, 18-B, 19-C, 19-D, 19-E, 20-B, 21-A, 22-A, 30-C, 31-A, 31-C, 31-F, 31-G, 35-A, 38-A, 39-A, 40-C, 44-A, 44-B, 44-C, 44-G, 44-H, 45-J, 45-N, 45-Q, 45-AA, 45-BB, 45-DD, 45-EE, 46-G, 46-J, 51-A.

SOLID WASTE

14-A, 18-A, 18-C, 32-B, 45-H, 45-Q, 46-B, 46-L, 46-O, 46-T, 47-A, 53-B through H. (See also Recycling and Litter Control)

SYNTHETIC FUEL

20-A, 45-Q, 45-EE.

TIDAL ENERGY

(See Ocean/Tidal Energy)

TOXIC SUBSTANCES

17-A, 22-A, 46-B, 46-N, 46-P, 46-U.

TRANSPORTATION

3-B, 12-A, 25-A, 27-A, 29-A, 29-B, 30-I, 32-B, 40-C, 45-A, 45-D, 45-J, 45-L, 45-Q, 45-W, 45-BB, 45-DD, 46-I.

WIND ENERGY

10-B, 18-A, 20-B, 31-A, 38-A, 44-T, 45-G, 45-H, 45-BB, 45-CC, 45-Q, 52-A.

SELECTED MULTIDISCIPLINARY REFERENCES

The following references contain material on energy and the environment which can be incorporated into the teaching of subjects other than science, i.e. math, social studies, history, language arts, art, etc.

3-C, 12-A, 15-B, 19-A, 21-A, 22-A, 30-B, 30-C, 30-D, 30-G, 30-H, 32-B, 35-A, 39-A, 41-A, 44-B, 44-J, 45-H, 45-J, 45-K, 45-L, 45-P, 45-W, 45-X, 45-Y, 45-Z, 45-CC, 45-DD, 53-A.